The Corps
of
Royal Canadian Electrical and Mechanical Engineers

The Land Engineering Test Establishment Capabilities Manual

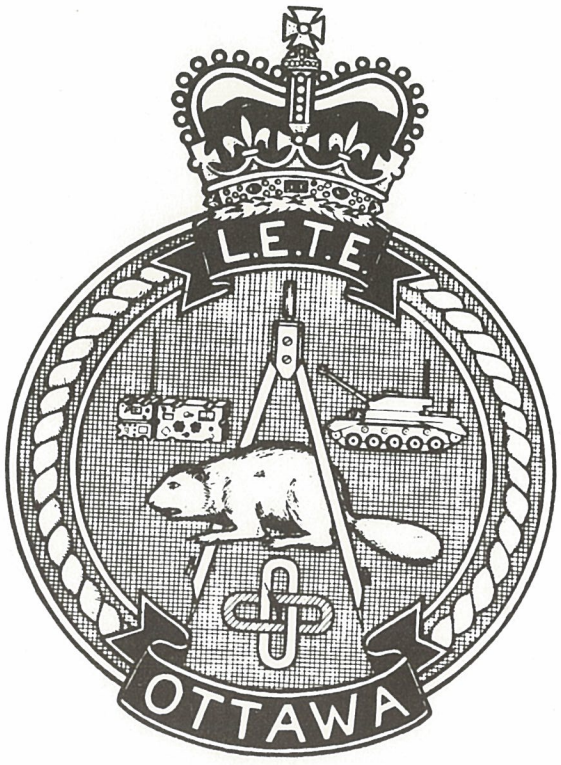




The RCEME Heritage Archives

CAPABILITIES

LETE



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FOREWORD

The Land Engineering Test Establishment Capabilities Manual has been prepared to provide interested parties with a brief description of the Unit, its organization, staff, facilities and equipment that enable the unit to carry out its role. This manual concentrates on the engineering test and evaluation functions of our role.

Comments, inquiries or suggestions should be directed to the Commanding Officer Land Engineering Test Establishment, Department of National Defence, Ottawa, Ontario, KlA 0K2.

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INTRODUCTION

A field unit of Assistant Deputy Minister Materiel (ADM(Mat)), the Land Engineering Test Establishment (LETE), was formed on 22 Mar 67 to consolidate functions formerly carried out by the Army Equipment Engineering Establishment, the Mobile Support Equipment Section of the Central Experimental Proving Establishment and the Naval Electronics Laboratory.

LETE occupies four locations in the Ottawa area. (Fig 1) The Proving Grounds is the home of the Unit Headquarters, most of Mobility Systems Engineering Squadron, Logistics Squadron Headquarters and the major portion of its warehouse facility and an armament engineering section and a small arms range from Land Tactical Electrical and Armament Engineering Squadron. It is located EAST of Ottawa at Orleans.

Building M-23 on the National Research Council site on Montreal Road houses most of the Land Tactical Electrical and Armament Engineering Squadron, a Logistics Squadron detachment and the Engineering Operations Cell of Plans, Control and Administration Squadron.

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The Airfield Support Equipment Section of Mobility Systems Engineering Squadron is located in Hanger 2 at CFB Ottawa (South) and a detachment of Logistics Squadron occupies part of the Elgar Building basement in downtown Ottawa.

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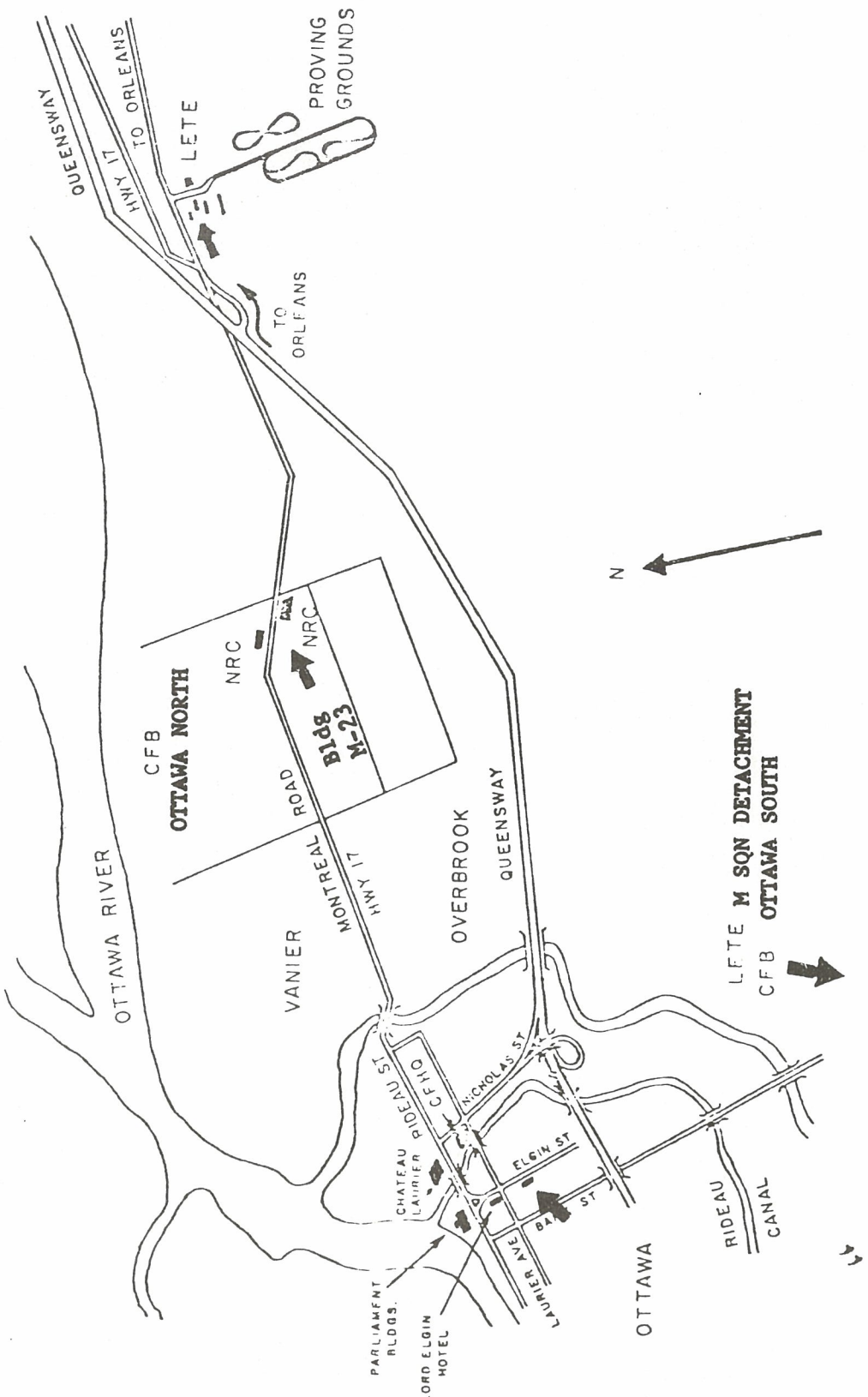

Figure No 1 -- Location Map of LETE

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ROLE

The role of LETE is to provide third line engineering and maintenance services.

The functions of LETE arising from this role are to:

- conduct or arrange to have conducted and to report on engineering tests and evaluations of land forces equipment, equipment in support of aerospace functions which is designated as Airfield Support Equipment and certain electrical and electronic equipment associated with Maritime and ground-based aerospace support systems;
- make technical studies of new ideas and concepts including practical verification of same;
- investigate failures and malfunctions of in service equipment and design remedies, if necessary;

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- from block communication system concepts design circuits, assemblies, electronic packages, interfaces and minor equipment, then breadboard, prototype, produce engineering models and preproduction samples, including associated technical information for the data package as required;
- from stated requirements, design, and fabricate and produce technical data package for tactical vehicle kits;
- produce as directed limited numbers of equipments where military in-house or industrial manufacture is not feasible;
- conduct or assist in demonstrations or displays of equipment, components or materiel;
- obtain equipments, components or materiel for tests, evaluations and technical studies. This may include manufacture in LETE workshops, purchase or rental by Standardization Loan Agreement or by demand from service supply sources;
- control and be accountable for equipments, components or materiel during the course of development projects;
- maintain special electronic equipment for land forces until normal repair depots are trained and equipped for servicing the item; and

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- provide use of facilities and services for other Government Departments and Civilian Agencies as directed.

CONTROL

Functional control of LETE (including technical control and tasking) is exercised by the Director General Land Engineering and Maintenance (DGLEM).

ORGANIZATION

LETE is organized on a functional basis as depicted in Figure 2.

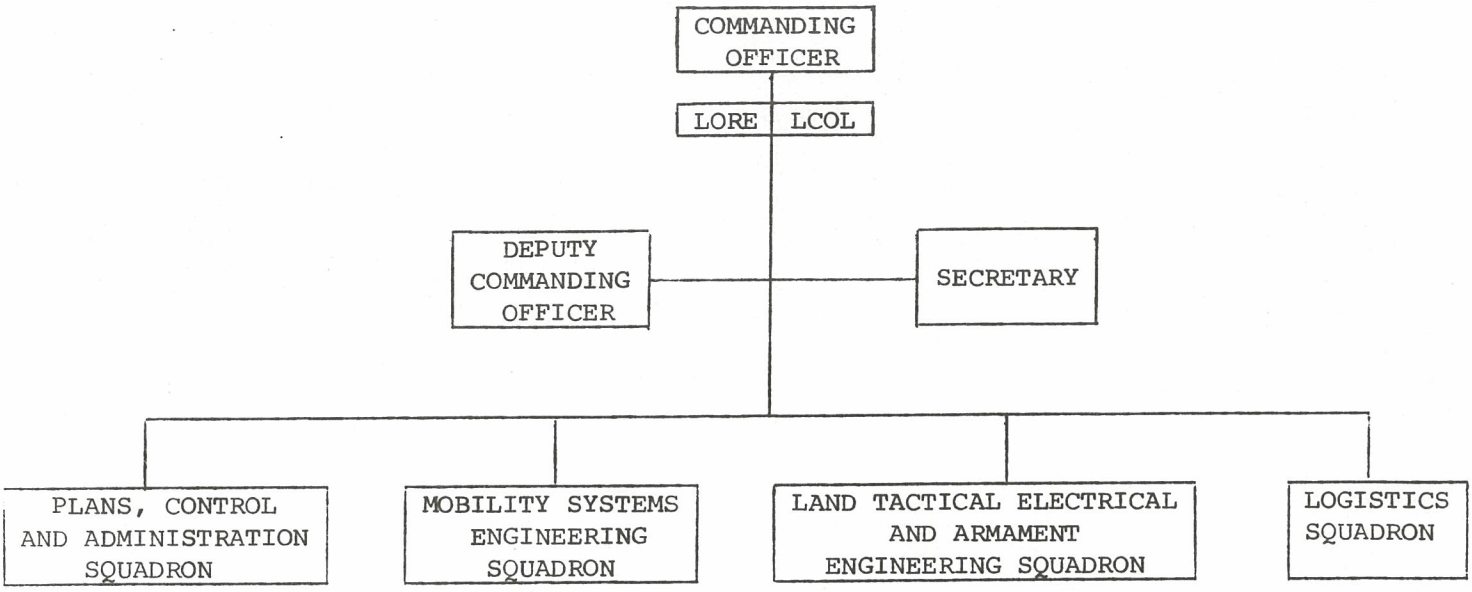

Figure No 2 -- LETE Organization

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Plans, Control and Administration Squadron (PCA SQN) (Fig 3) has three areas of responsibility:

- technical administration;
- personnel administration; and
- co-ordination of training.

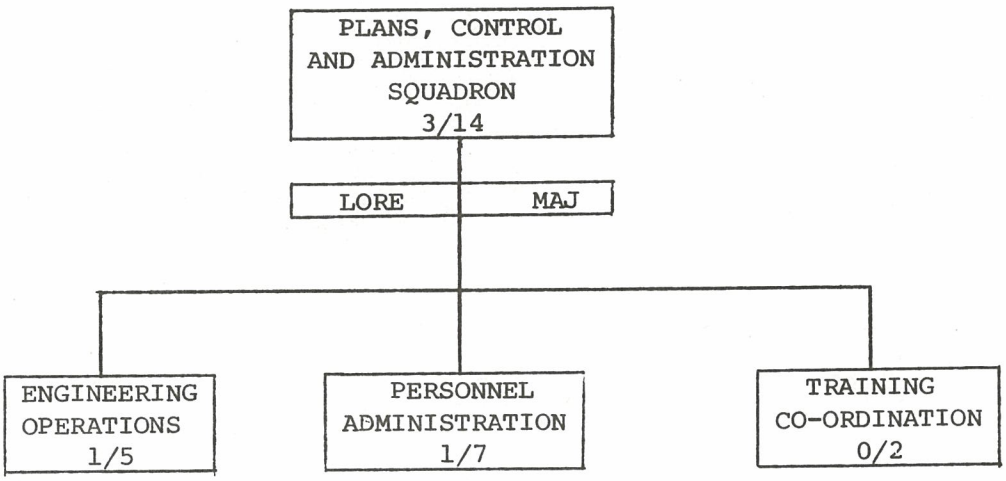

Figure No 3 -- PCA Sqn

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Mobility Systems Engineering Squadron (M SQN) (Fig 4) is organized to cater primarily to the test, evaluation and investigation of land vehicles and equipment including airfield support equipment. The SQN has internal support, available to other SQNs as well, that provides maintenance, fabrication, test instrumentation and photography. A detailed description of M SQN facilities commences on page 15.

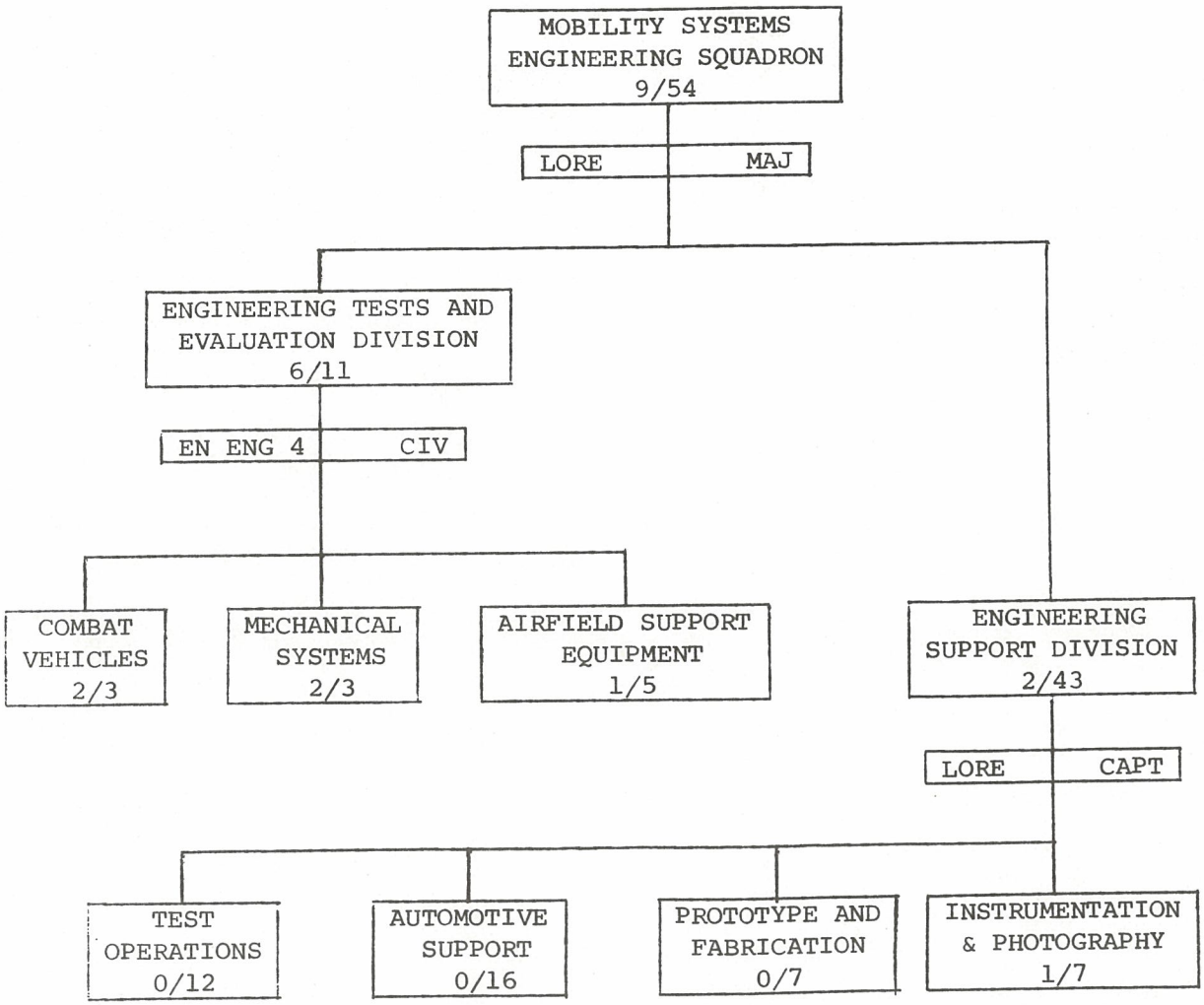

Figure No 4 -- M Sqn

The Land Tactical Electrical and Armament Engineering Squadron (E SQN) (Fig 5) is responsible for conducting tests, evaluations and development engineering on communications, weapons and fire control systems as well as on general electronic and electrical equipment for land aerospace and Maritime agencies. In addition, E SQN controls the main non-vehicle workshops and engineering laboratories that support all projects in the unit. A detailed description of E SQN facilities commences on Page 24.

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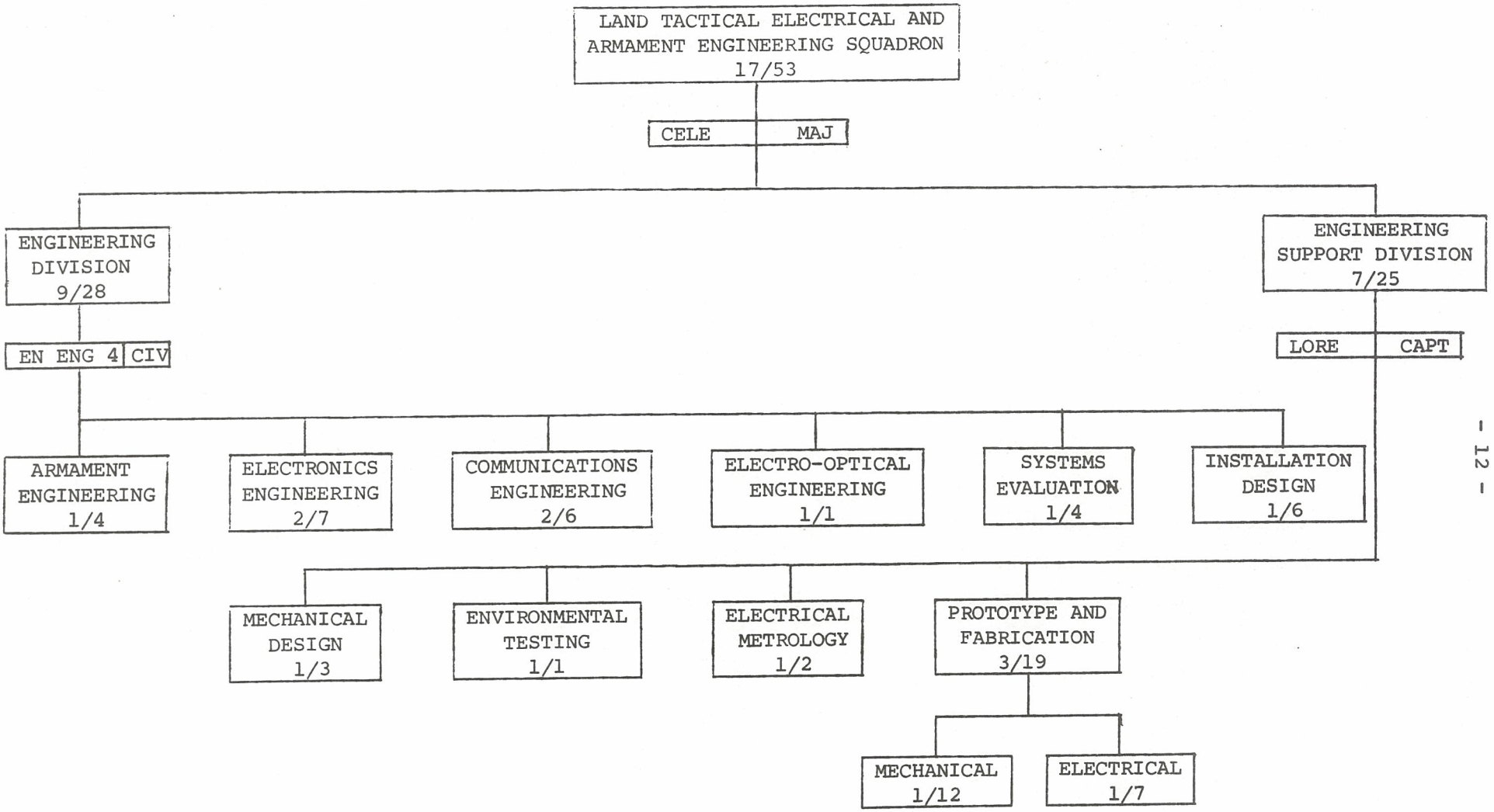
LAND TACTICAL ELECTRICAL AND ARMAMENT ENGINEERING SQUADRON 17/53
CELE
MAJ
ENGINEERING DIVISION 9/28
EN ENG 4
CIV
ENGINEERING SUPPORT DIVISION 7/25
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Logistics Squadron (LOG SQN) (Fig 6) is responsible for controlling, accounting for and warehousing stores as well as the purchasing of project material. The Sqn detachment at NDHQ is responsible for holding clothing and equipment for test and evaluation by the Directorate of Clothing and General Engineering and Maintenance. In addition, it holds the sealed patterns which are the uniform and acoutrements specification documents.

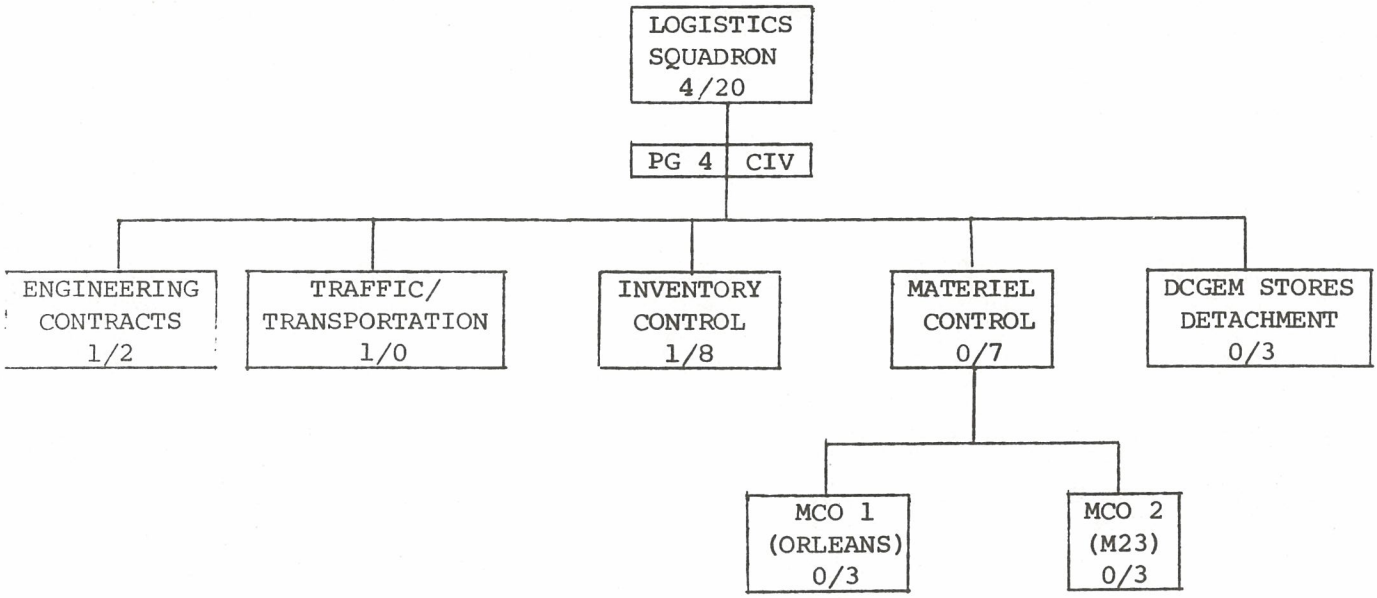

Figure No 6 -- Log Sqn

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CAPABILITIES

LETE has been established to meet the engineering test and development needs of the Director General Land Engineering and Maintenance as well as providing support for in-service equipment. It also serves the engineering and maintenance directorates of the Maritime, the Aerospace and the Communications Electronics Divisions of NDHQ.

The combination of staff, facilities and equipment provides LETE with the capability required to fulfill its role.

A description of M SQN and E SQN facilities and equipment commences on pages 15 and 24 respectively.

STAFF

The permanent staff at LETE is made up of 177 engineers, technicians, technologists, and support personnel.

M SQN FACILITIES

The facilities at the Proving Grounds, controlled by M SQN, make LETE unique among testing establishments. Developed and constructed during WWII, the tracks, slopes and special courses provide a facility for the testing and development of military vehicles. The hills, swamps, wooded areas, open fields, rock and sand provide most of the natural terrain one might encounter. These features together with 10.2 miles of test track (Fig 7) and slopes to a maximum of 60% gradient (Fig 8) make it possible to carry out the following engineering tests:

- maximum speed;
- acceleration;
- braking;
- traction;
- power;
- fuel consumption;
- turning radius;
- durability; and
- centre of gravity.

Annex A contains a list of the various automotive test courses and facilities. A map of the LETE Test Facility is attached as Annex B.

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Figure No 7 -- The main test track. The 1/4 mile straight-away is on the left and part of mile oval on the right. (Neg No EE77 1010)

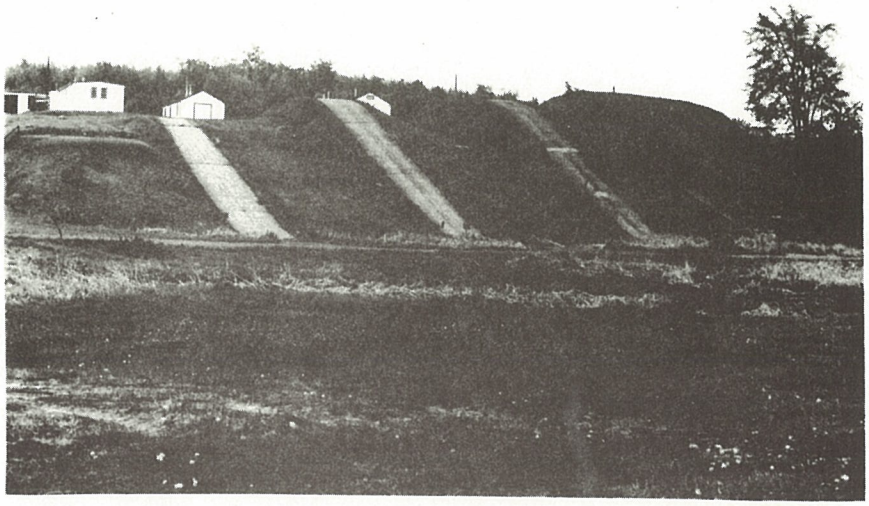

Figure No 8 -- The 30, 40, 50 and 60 percent slopes. Note that the 60% is in the process of being re-surfaced. (Neg No EE77 1006)

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Some of the more specialized facilities that further the test and evaluation capability are pictured opposite. Stability tests are done on a tilt table (Fig 9), amphibious vehicles are evaluated in a wading tank (Fig 10), and suspension and articulation tests can be carried out on courses of granite blocks, belgian pavé, or one of corrugated concrete that varies in pitch and amplitude along its length. (Fig 11)

Another unique facility gives LETE the capability of simulating the operation of runway sweepers. (Fig 12)

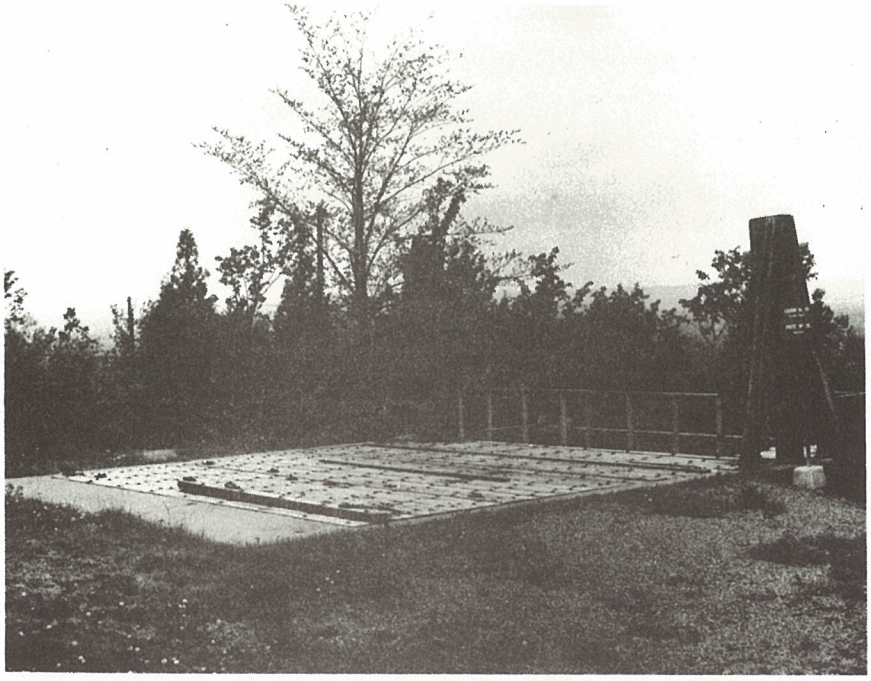

Figure No 9 -- The Tilt Table.
(Neg No EE77 1009)

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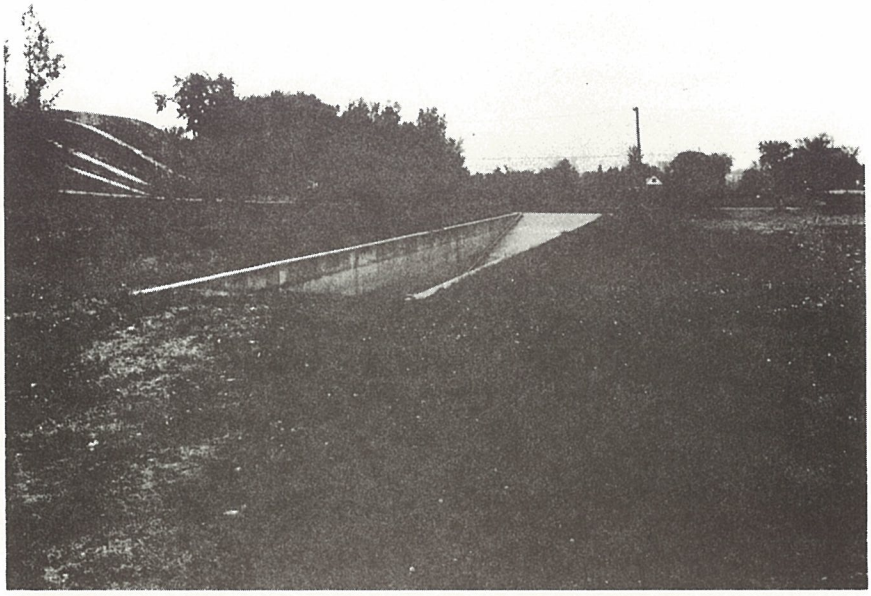

Figure No 10 -- The Wading Tank.
(Neg No EE77 1007)

Figure No 11 -- Suspension and Articulation Tracks.
(Neg No EE77 1008)

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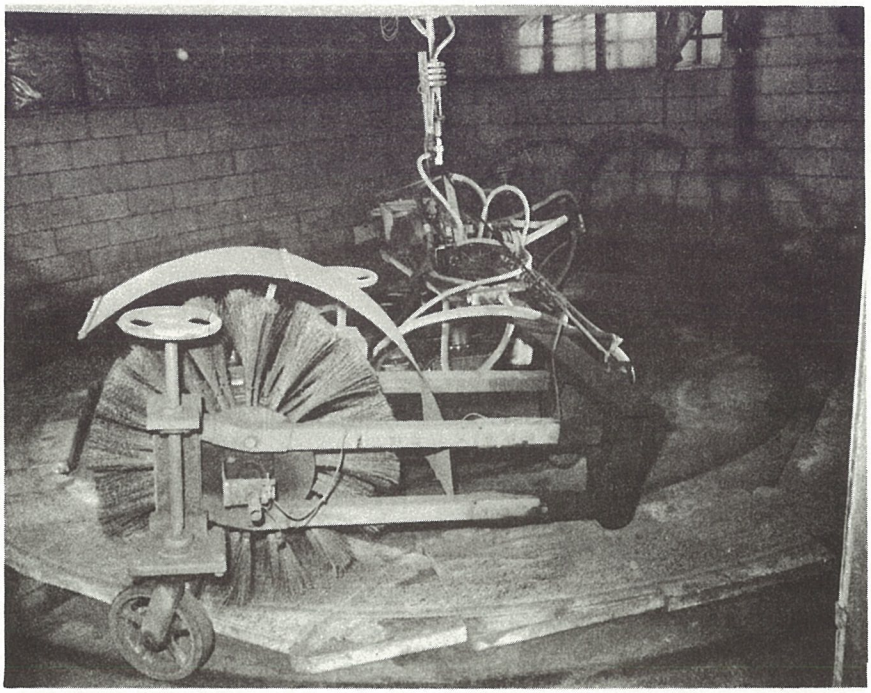

Figure No 12 -- Runway Sweeper Test Rig.
(Neg No EE75 0251)

M SQN EQUIPMENT

The Instrumentation section holds and operates the various mechanical and electronic devices required for the gathering of quantitative performance data of equipment under evaluation.

The general capabilities of the section are summarized in Table 1 below. Specific equipment is illustrated in Annex C as indicated. Automatic recording is done for several parameters using the recorders shown overleaf.

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AREA OF INTEREST	RANGE	PAGE OF ANNEX C
Distance	1/100 millimeter to 10,000 ft	1
Weight and Force	1/10 gram to 50,000 lbs	2, 5
Pressure	1 millimeter mercury to 10,000 lbs	2
Linear Velocity	0 to 100 miles per hour	1
Angular Velocity	0 to 10,000 revolutions per minute	3
Acceleration	to 1,000 g	
Torque	to 10,000 inch pounds	
Temperature	minus 80°F to plus 3,000°F	4
Stress and Strain	to 10,000 micro inches per inch	5
Sound	flat, A, B, and C weighing to 150 dB	6

Table No 1 -- Range of M Sqn Instrumentation

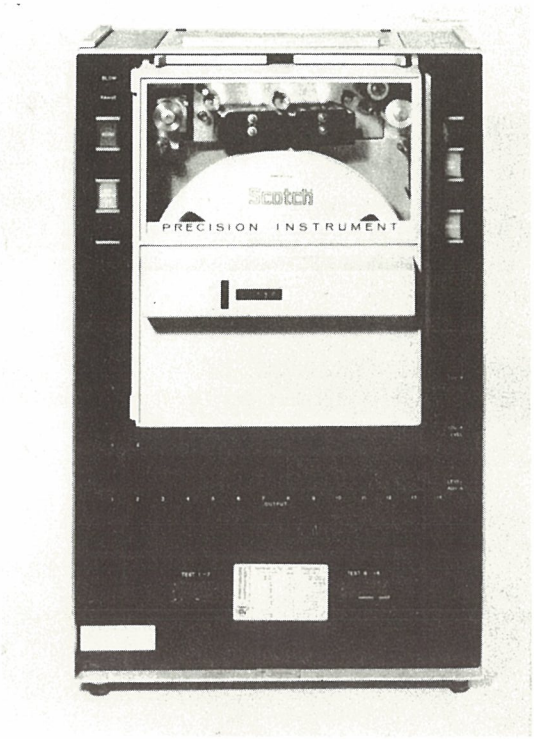

Figure No 13

MAGNETIC TAPE RECORDER. Used to record tranducer signals in recording shock and acceleration associated with vibration. It can handle up to 14 channels.

(Neg No EE77 0437)

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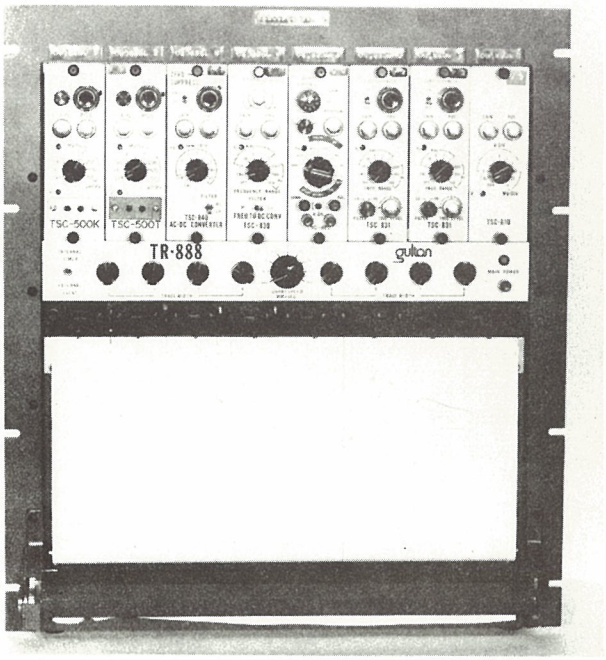

Figure No 14

EIGHT CHANNEL RECORDER. Gulton Eight Channel Recorder Model TR 888. A compact eight channel direct writing analog recorder which uses a heated stylus or heat sensitive paper. Each of the eight channels can be individually "programmed," with a range of signal conditioners, to accept and record signals from a wide range of transducers such as thermocouples, strain gauges, etc.

(Neg No EE77 0438)

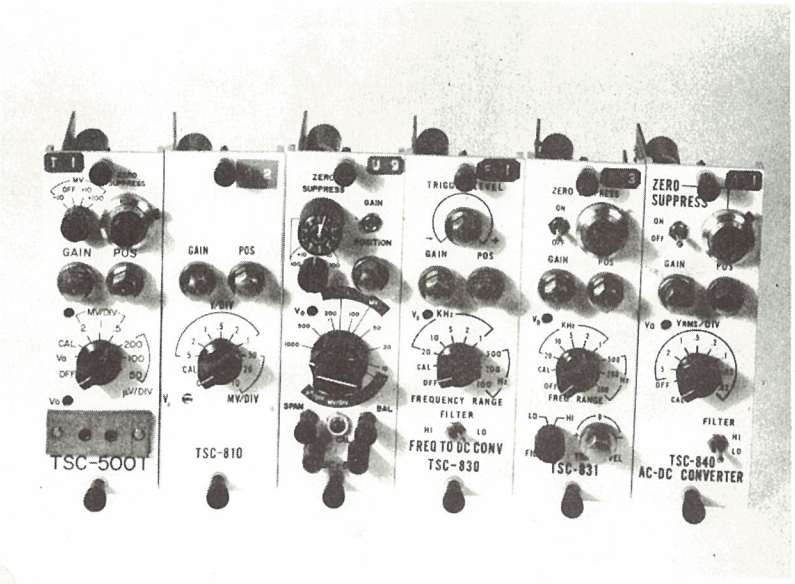

Figure No 15

SIGNAL CONDITIONERS FOR CHART RECORDER TR 888. These plug in units are used to "condition" the output signal from transducers to allow input into the TR 888 Recorder. They can be used to scale the input so that the output from the recorder can be directly read in engineering units.

(Neg No EE77 0426)

The LETE Photo Section is in M Sqn. In addition to providing photographic documentation of equipments and components, high speed motion picture photography gives a capability of gathering qualitative data during mobile tests. The section is equipped to develop and display most photos it takes. The major photo equipments are described in Annex D.

The M SQN Workshops (Figs 16 & 17) are equipped to give LETE its capability of providing support for commercial and military prototype and in service equipment, particularly vehicles, in the form of failure and unsatisfactory condition report (UCR) investigations, as well as providing maintenance support to engineering tests. In addition, a limited amount of vehicle kitting and prototyping is done in the carpenter, welding and machine shops.

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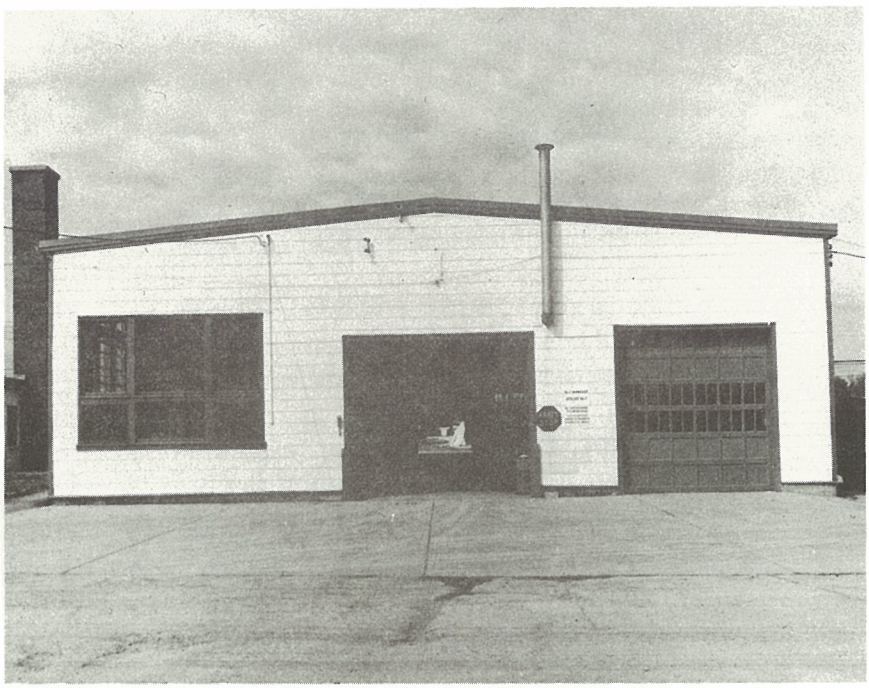

Figure No 16 -- Workshop No 1 houses the vehicle inspection and repair sections. (Neg No EE77 1011)

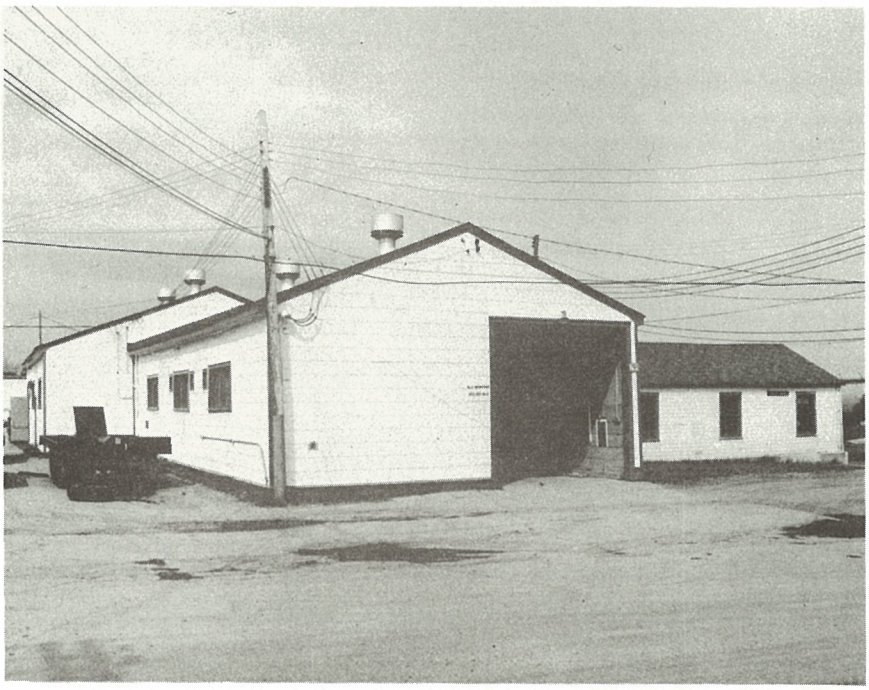

Figure No 17 -- Workshop No 2 houses the carpenter, welding and machine shops. (Neg No EE77 1012)

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E SQN FACILITIES

E SQN occupies most of Building M-23 on the National Research Council site on Montreal Road. Here, several electronic laboratories are housed within which prototypes of land tactical electronic, communication and electrical devices, equipments and systems are developed. (Figs 18 and 19) The kits required for the installation of these equipments in wheeled and tracked vehicles and shelters are also developed here. (Fig 20) As well, systems checks, including electromagnetic compatibility measurements, (Fig 21) engineering evaluation of contractor provided equipments, and failure investigations of in-service equipments are undertaken.

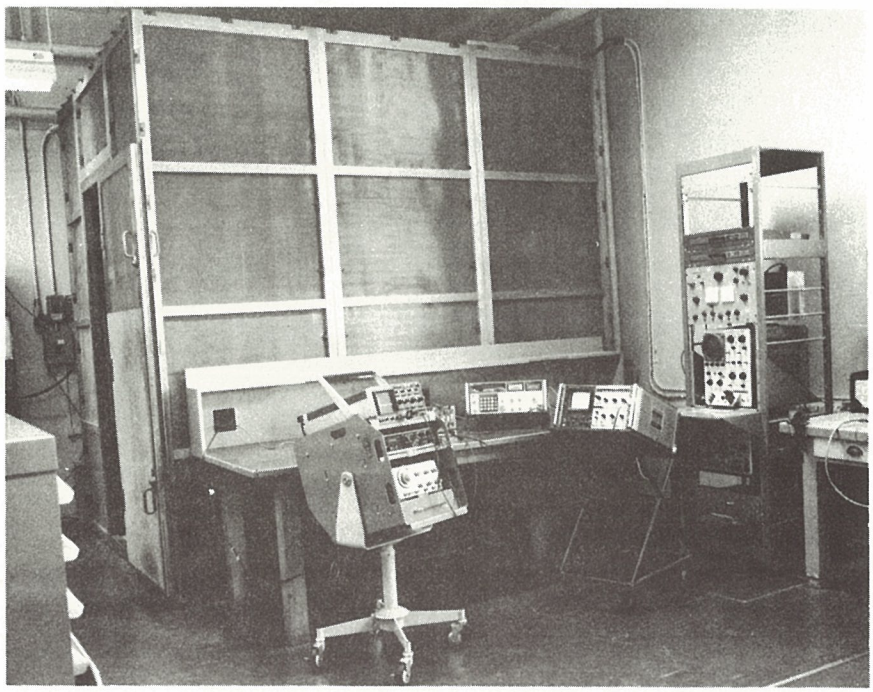

Figure No 18 -- Part of the Communications Engineering Laboratory. (Neg No EE77 1016)

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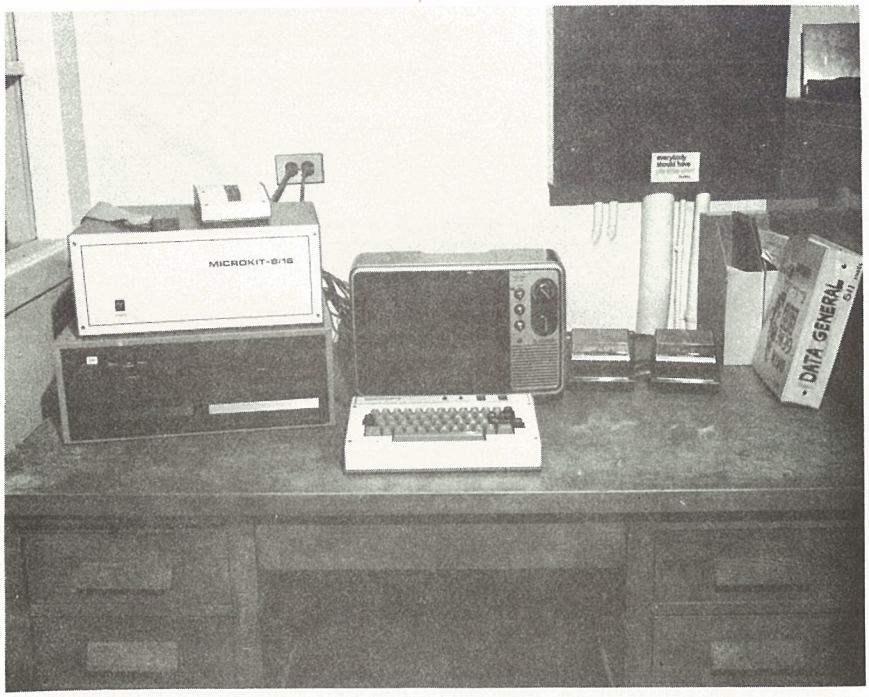

Figure No 19 -- The Micro Computor Development Centre in the Electronics Engineering Laboratory.
(Neg No EE77 1018)

Figure No 20 -- An example of a prototype installation developed by the Installations Design Section.
(Neg No EE77 1040)

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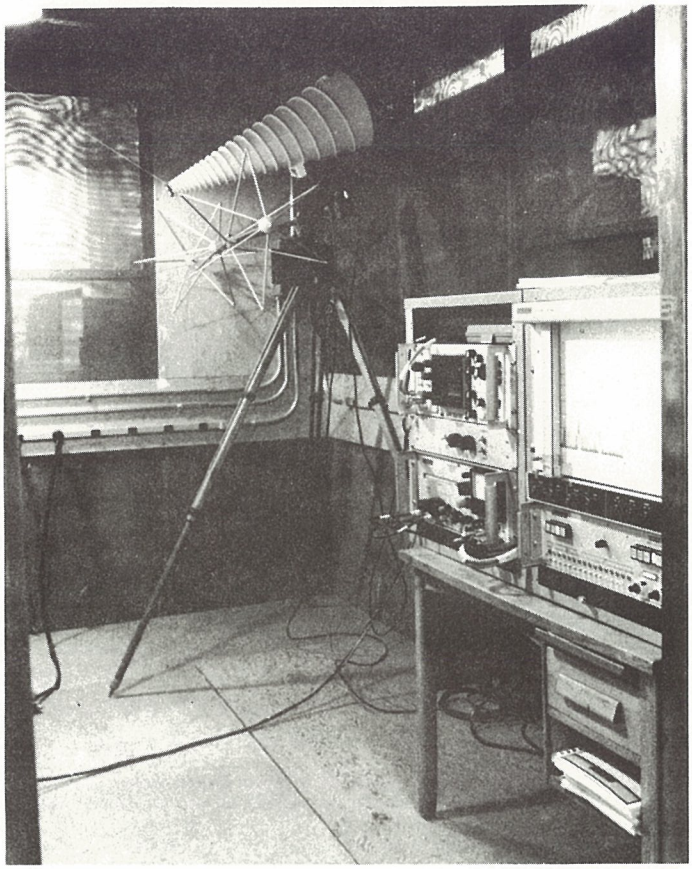

Figure No 21 -- Equipment undergoing electromagnetic compatibility testing.
(Neg No EE77 1019)

These labs are supported by a printed circuit board facility (Fig 22) that takes on outside production as well and a less sophisticated electro-plating (Fig 23) facility.

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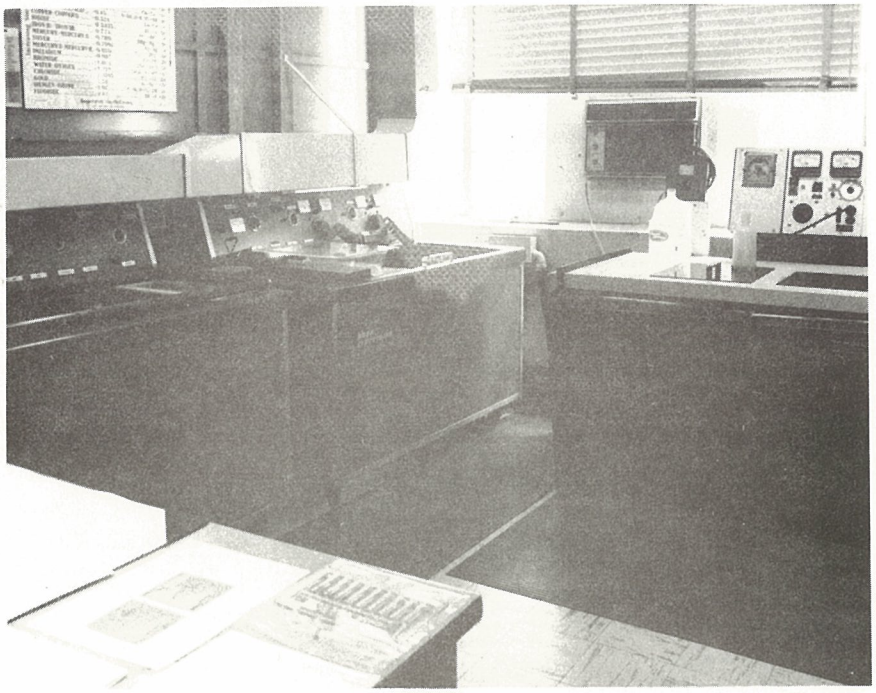

Figure No 22 -- Part of the Printed Circuit Board Facility.
(Neg No EE77 1024)

Figure No 23 -- The Electro-Plating Facility.
(Neg No EE77 1015)

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An environmental lab gives E SQN the capability of conducting the following extreme condition tests:

- vibration;
- rain;
- altitude (with temperature and humidity control);
- acceleration;
- drop;
- shake;
- shock loading;
- salt spray; and
- thermal shock (both hot and cold)

The environmental lab also includes a walk-in humidity controlled cold chamber.

LETE's main prototype and fabrication facility (Fig 24) is in M-23 as well. It is equipped to carry out all aspects of sheet metal work and machine tooling including general machining, tool and die, heat treatment and all types of welding. In addition, it has plastic and rubber moulding capability. (Fig 25)

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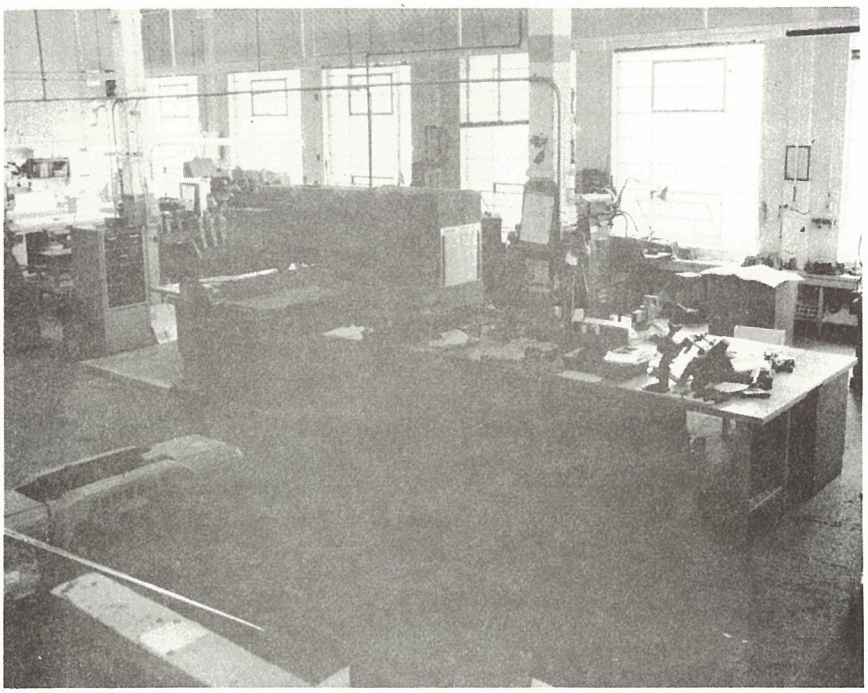

Figure No 24 -- Part of the Prototype and Fabrication Workshop. (Neg No EE77 1020)

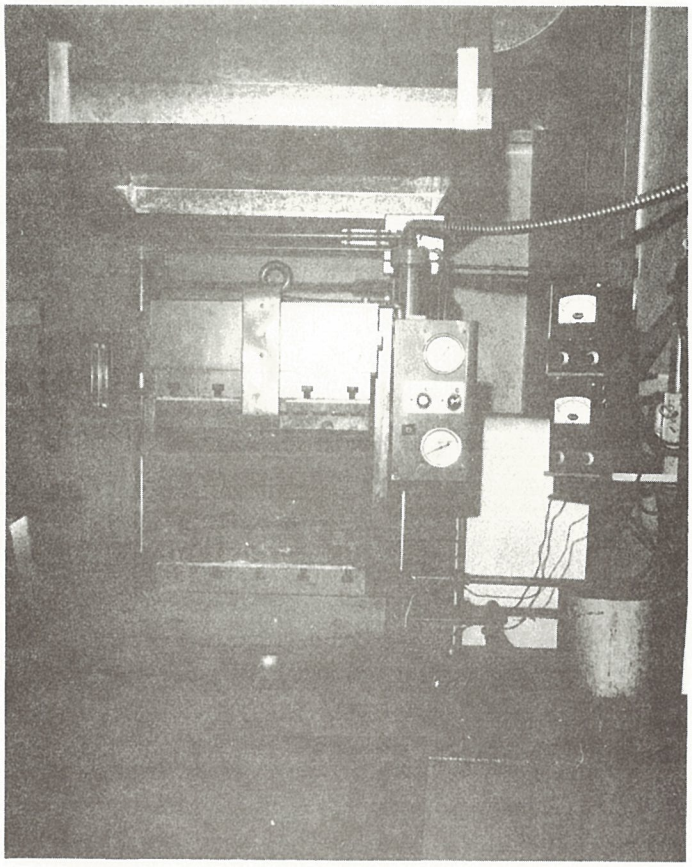

Figure No 25 -- Rubber Moulding Machine.
(Neg No EE77 1021)

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The armament engineering section has offices in M23 with a workshop and 100m small arms range (Fig 26) at the Proving Grounds in Orleans. Facilities are available for the test and evaluation of weapons and weapon systems up to and including 40mm, along with the related ancillary equipments.

A small mechanical design section is also available to undertake tasks either from NDHQ directorates, or in support of unit project officers. (Fig 27)

Figure No 26 -- The 100 metre Small Arms Range.
(Neg No EE77 1068)

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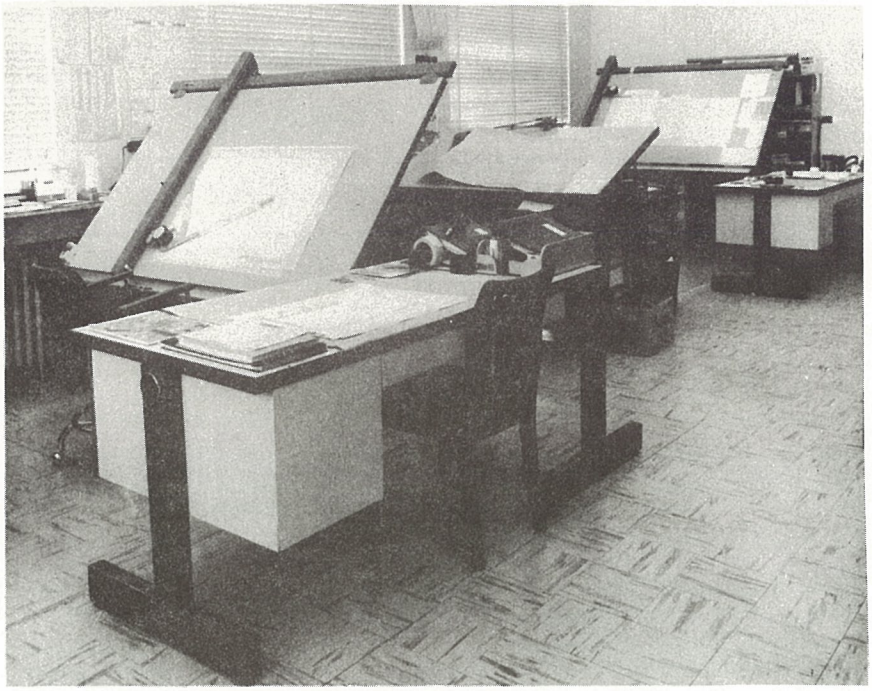

Figure No 27 -- Part of the Mechanical Design Section.
(Neg No EE77 1017)

E SQN EQUIPMENT

The capability of an electronics laboratory lies with skilled personnel and a complete inventory of equipment. LETE has the capability to design and test equipment and systems ranging in frequency from audio to over 400 MHz including telephone teletype and radio using analog or digital techniques. The LETE labs handle all types of electronic equipment including fire control systems. Annex E contains a list of the types of electronic test equipment held by E SQN. The Environmental Test Section is

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equipped to test components under most conditions that might be encountered. This equipment is described in Annex F. Annex G contains a list of the major equipments held in the Prototype and Fabrication Section.

ANNEX B TO
CAPABILITIES LETE

COURSE NO	SURFACE	TYPE OF COURSE	LENGTH (YDS)
1	Concrete	Level Road	5117
2	Concrete	Road with Grades of 10%	
8	Concrete	Acceleration Tests	1320
9	Concrete	Measured 1/4 Mile in No 8	440
11	Rutted Field	Suspension Tests	
15	Sand Patch	Cooling & Mobility Tests	
16	Clay & Gravel	10% Slope	130
17C & D	Gravel	15 & 20% Slope	75
17E to 17H	Concrete	30,40,50,&60% Slope	83
19	Grass over Clay	15 to 30% Slope Stepped	66
20	Wet Clay Land	Soft Soil Mobility Tests	
21	Clay Slope	15% Slope	80
23	Concrete	Water Wading Tank (8 ft max depth)	
24	Water-bound Macadam	Light Cross-Country	1854
25	Loam-clay Rock & Gravel	Medium Cross-Country	shared w/water reservoir
26	Loam-clay Rock & Gravel	Heavy Cross-Country	1583
27	Clay, Rock & Gravel	Medium Alpine	620
28	Clay, Rock & Gravel	Steep Alpine	150
29	Granite Blocks	Durability & Articulation	220
30	Corrugated Concrete	Articulation	270
31	Belgian Pavé	Durability & Articulation	270
33	Concrete Articulation Gauges	Twister, Undercarriage & Frame Ground Clearance	
34	Controlled Mud Tank (unserviceable)	Soft Soil Tests	100
35		Tilting Table	
36A	Concrete	Loading Ramp	
36C	Concrete	Turning Circle	83 (Dia)
37	Rock Outcroppings	Track Durability Course	1634
38	Weathered Limestone	Suspension & Track Tests	864
39	Soft Boggy Land	Traction Aid & Soft Soil Mobility Tests	
40		Bridging Ramp	
41	Rutted Field	Suspension Tests	
42	Loose Sand	Steering Tests	

BLDG NO	DESIGNATION
290	GUARD HOUSE
291	RADIO MAT LAB
292	No 1 WORKSHOP
293	No 2 WORKSHOP
294	TEST DIV PROJECT STORES
295	UNIT MT OFFICE
297	LUMBER STORES
298	OIL SHED
300	MT SERVT SECTIONS
302	LECTURE ROOM
303	TEST DIV HQS
306	FIRE HALL
313	No 6 GM BLDG
316	EXPLOSIVES LAB
319	MAGAZINE
324	No 3 GM BLDG
349	CANTEEN
350	No 7 GM BLDG
351	WHSE No 8 TEST DIVISION
352	No 1 GM BLDG
353	GM STORAGE BLDG
354	GROUND MAINT STORES

SCALE ONE INCH ONE HUNDRED AND FIFTY FEET 1/600

150 100 50 0 150 300 450 600 750 900 1000 FEET

100 75 50 25 0 100 200 300 YARDS

APPROXIMATE MEAN DECLINATION 1960
THE VARIATION OF THE COMPASS NEEDLE
IS DECREASING 9/10 OF A MINUTE ANNUALLY

ELEVATION OF POINT ABOVE SEA LEVEL SHOWN 260.5
MAIN ROAD 20°57' WEST OF TRUE NORTH
MAGNETIC BEARING 14°09' WEST OF TRUE NORTH

DRAWN H.R.G.	1800	DIRECTOR GENERAL ORDNANCE SYSTEMS OTTAWA CANADA	C REVISED & REDRAWN 10/1956 17 APR 67
TRACED H.R.G.		"M" MAP, LAND ENGINEERING TEST ESTABLISHMENT	
CHECKED H.L. CAMILL			
APPROVED 13 JUN 60			H 352030
R.C. LANE MAJ			

ANNEX A TO
CAPABILITIES LETE

AUTOMOTIVE TEST COURSE AND FACILITIES

COURSE NO	SURFACE	TYPE OF COURSE	LENGTH (YDS)
1	Concrete	Level Road	5117
2	Concrete	Road with Grades of 10%	
8	Concrete	Acceleration Tests	1320
9	Concrete	Measured 1/4 Mile in No 8	440
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19	Grass over Clay	15 to 30% Slope Stepped	66
20	Wet Clay Land	Soft Soil Mobility Tests	
21	Clay Slope	15% Slope	80
23	Concrete	Water Wading Tank (8 ft max depth)	
24	Water-bound Macadam	Light Cross-Country	1854
25	Loam-clay Rock & Gravel	Medium Cross-Country	shared w/water reservoir
26	Loam-clay Rock & Gravel	Heavy Cross-Country	1583
27	Clay, Rock & Gravel	Medium Alpine	620
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31	Belgian Pavé	Durability & Articulation	270
33	Concrete Articulation Gauges	Twister, Undercarriage & Frame Ground Clearance	
34	Controlled Mud Tank (unserviceable)	Soft Soil Tests	100
35		Tilting Table	
36A	Concrete	Loading Ramp	
36C	Concrete	Turning Circle	83 (Dia)
37	Rock Outcroppings	Track Durability Course	1634
38	Weathered Limestone	Suspension & Track Tests	864
39	Soft Boggy Land	Traction Aid & Soft Soil Mobility Tests	
40		Bridging Ramp	
41	Rutted Field	Suspension Tests	
42	Loose Sand	Steering Tests	

M SQN EQUIPMENT - INSTRUMENTATION SECTION

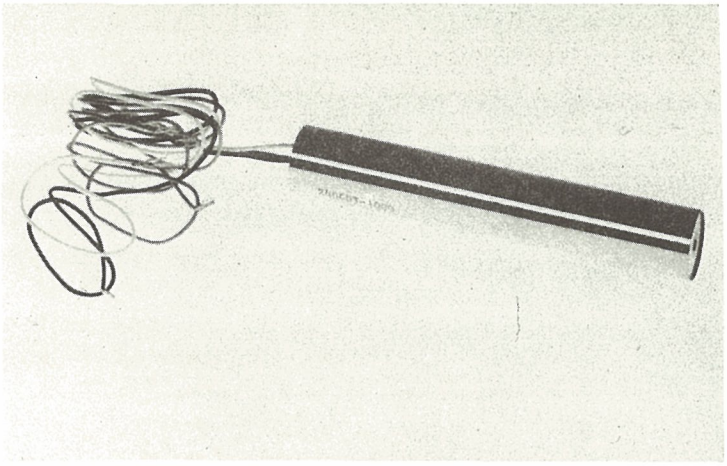

Figure No 28

HEWLETT PACKARD 24 DCDT-1000 DISPLACEMENT TRANSDUCER. Used to measure and record mechanical displacements where high accuracy and resolution are desired.

(Neg No EE77 0434)

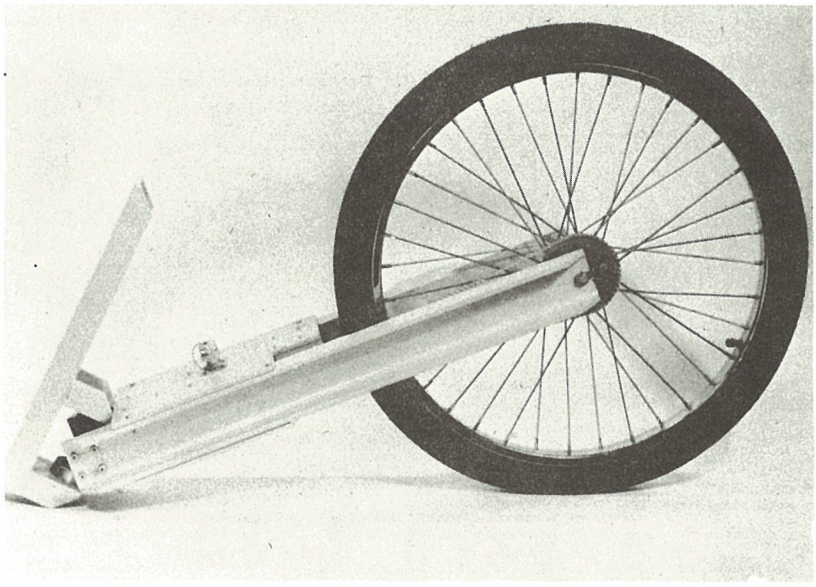

Figure No 29

LETE FIFTH WHEEL MARK I. An electronic/mechanical transducer used to provide a distance input to a fifth wheel calculator.

(Neg No EE77 0424)

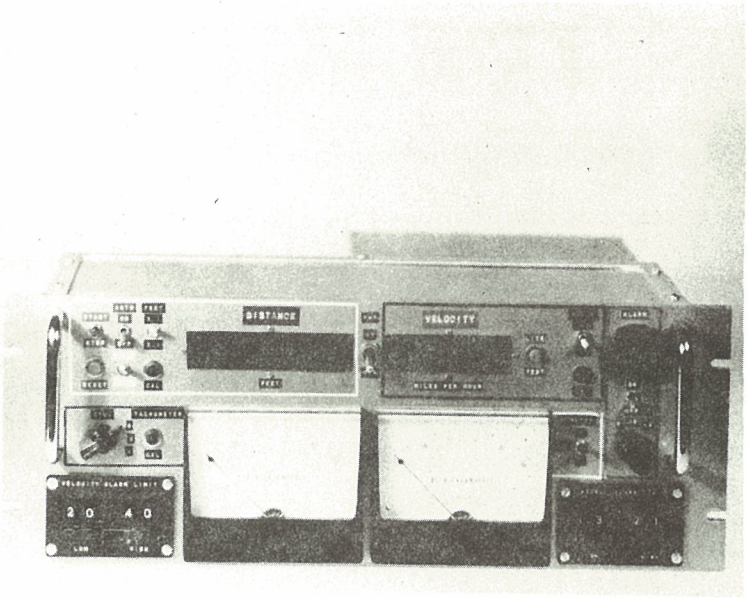

Figure No 30

FIFTH WHEEL LOGIC BOX. Used in conjunction with a fifth wheel. Distance and Velocity are digitally displayed while acceleration and engine RPM are displayed by front meters. Analogue outputs are available for all functions for recording purposes.

(Neg No EE77 0429)

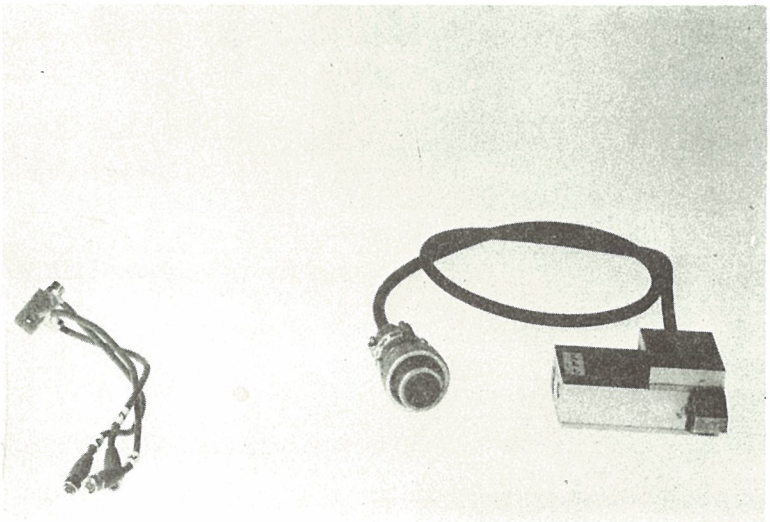

Figure No 31

PIEZOELECTRIC (LEFT) AND A STRAIN GAUGE TYPE ACCELEROMETER (RIGHT).

(Neg No EE77 0422)

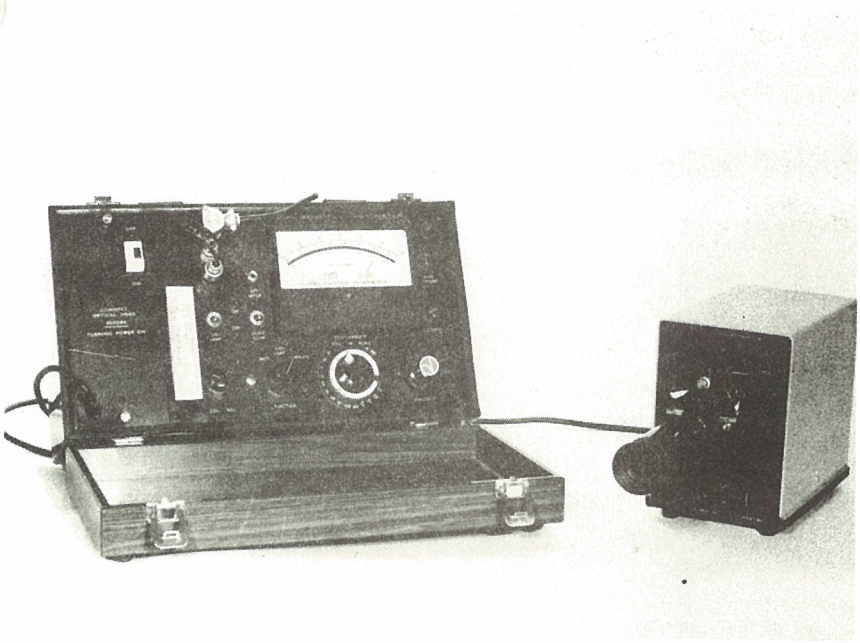

Figure No 32

GAMMA SCIENTIFIC MODEL 2000 TELEPHOTOMETER. Is a high resolution, high sensitivity instrument for measuring the luminance of distant surfaces.

(Neg No EE77 0432)

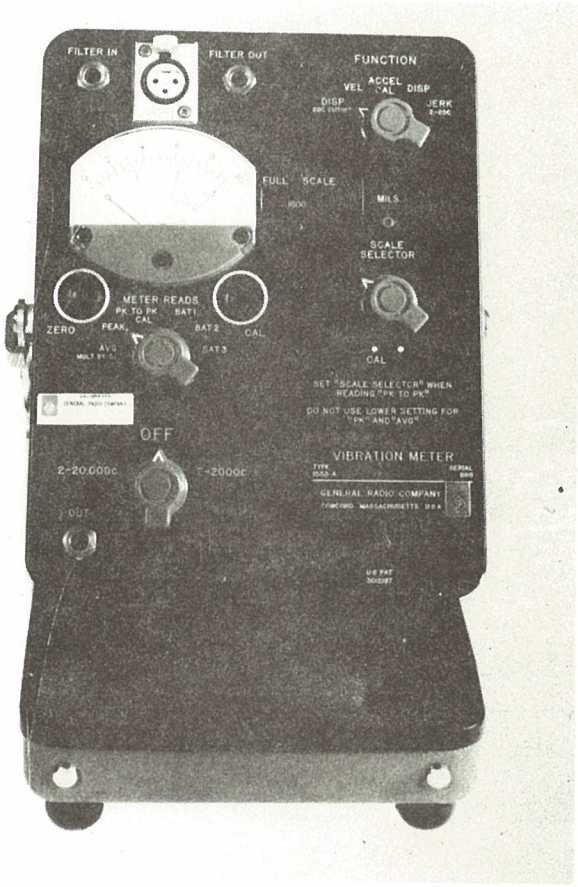

Figure No 33

GENERAL RADIO TYPE 1553-A VIBRATION METER. Is a portable, general purpose instrument for measuring mechanical vibration and provides a direct reading of acceleration, velocity, displacement and jerk.

(Neg No EE77 0435)

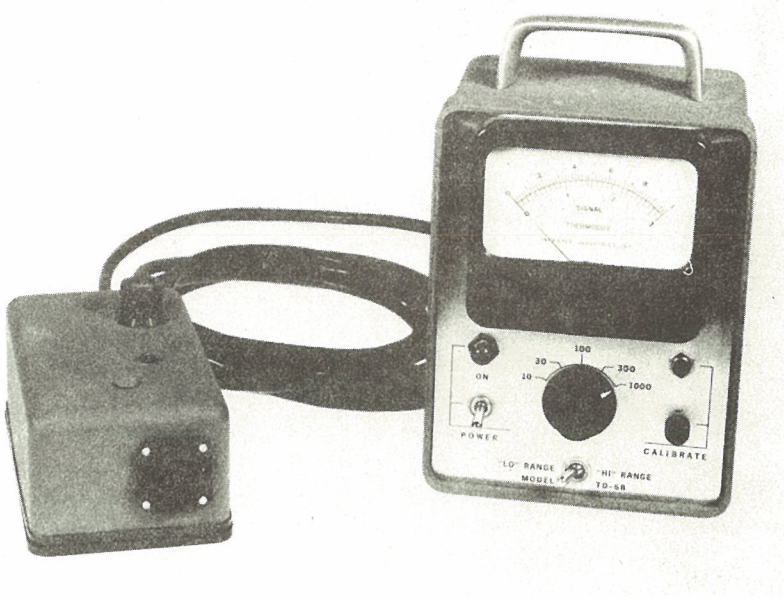

Figure No 34

THERMODOT. Is used to determine temperatures emitted by objects from a safe distance. It operates on the principle of infra-red emissions of heated bodies.

(Neg No EE77 0427)

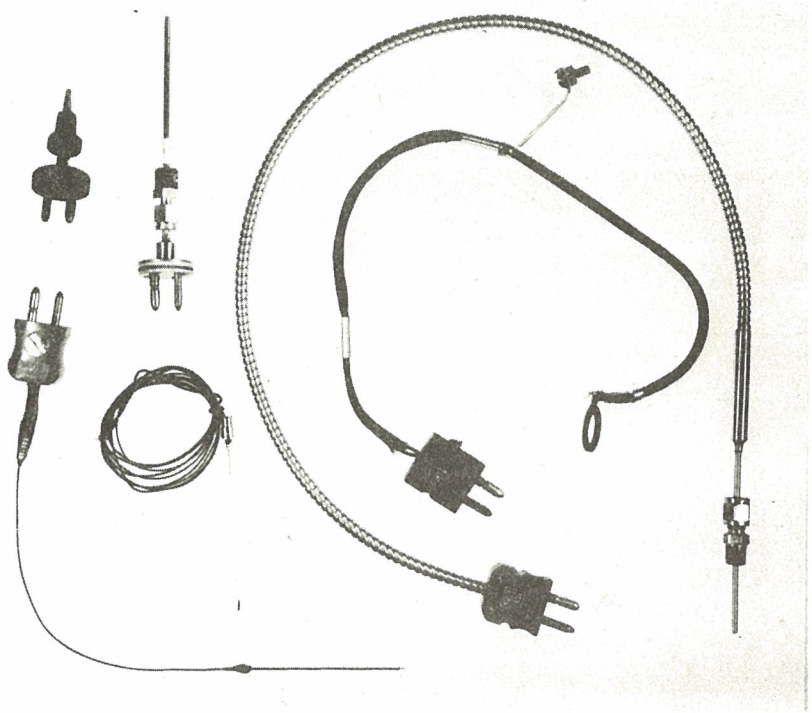

Figure No 35

THERMOCOUPLES. Shows different styles of thermocouples such as steel and glass jacketed, hypodermic, flex probe and 0 Ring type for cylinder head temperatures.

(Neg No EE770436)

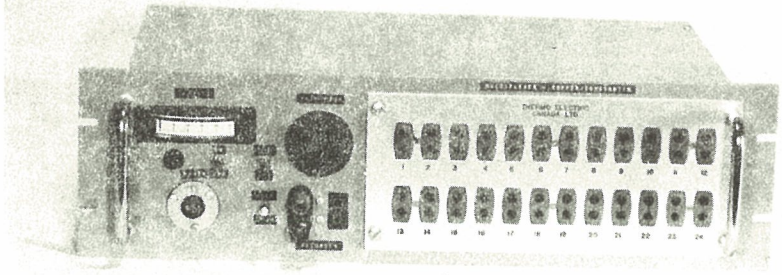

Figure No 36

THERMOCOUPLE MULTIPLEXER. Is used to MUX up to 24 thermocouple inputs onto two channels. Available for T and J type inputs.

(Neg No EE77 0425)

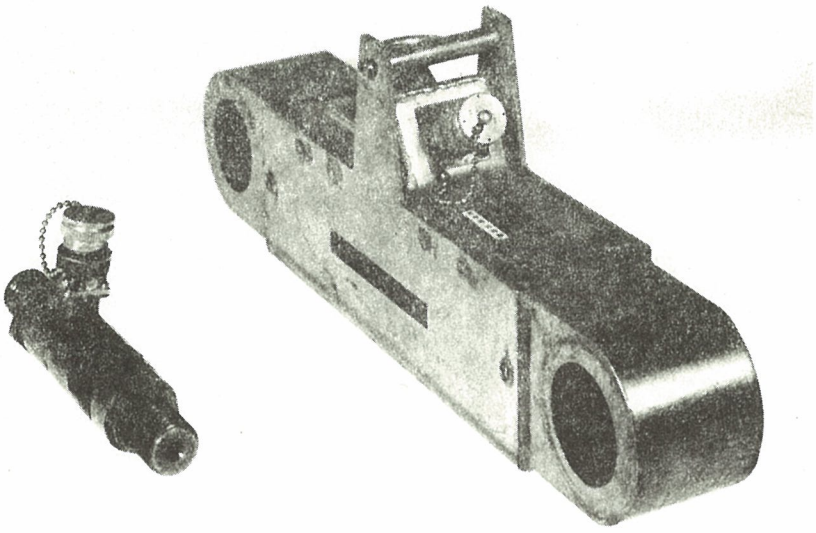

Figure No 37

DRAWBARS. Shows the range of strain gauge type drawbars available. The one on the left is of 1000 lb capacity and the right is 50,000 lb capacity.

(Neg No EE77 0423)

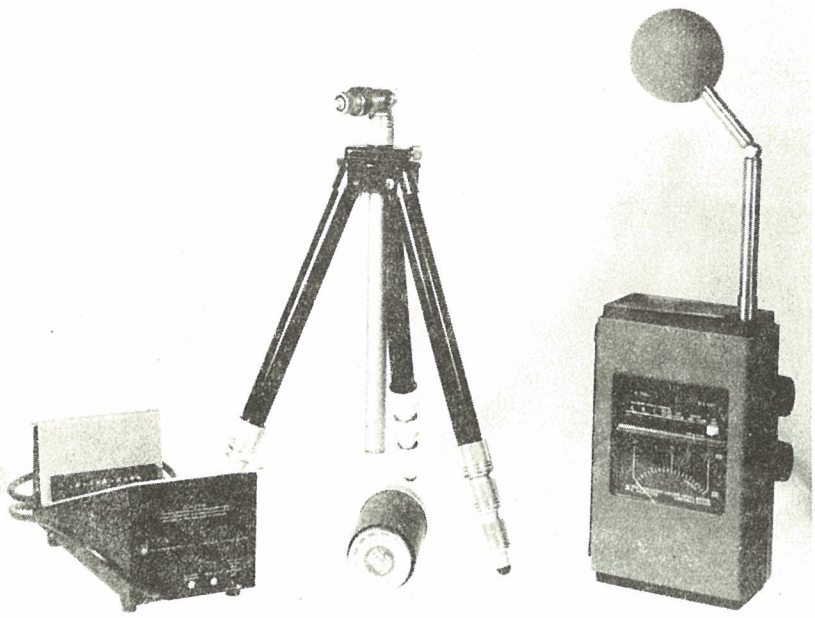

Figure No 38

SOUND METER. Used to record the dB level of sound and has flat, A, B, and C weighing factors. It also contains switch selectable filters to determine levels at different centre frequencies.

(Neg No EE77 0428)

M SQN EQUIPMENT - PHOTOGRAPHIC SECTION

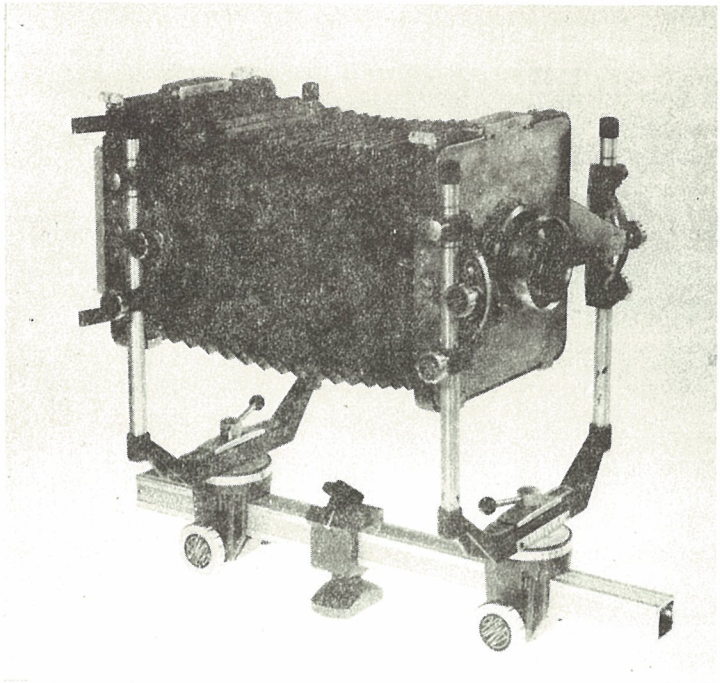

Figure No 39

CAMERA, STILL PICTURE 4x5 SUPERCAMBO II. A general purpose studio and view camera.

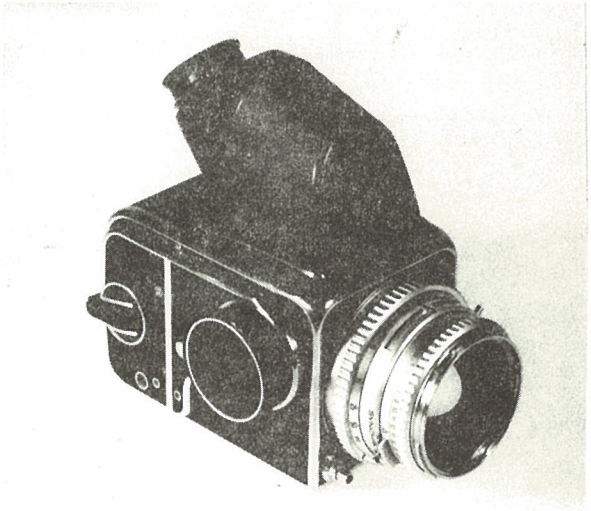

Figure No 40

CAMERA, STILL, PHOTO 2¼ x 2¼ HASSELBLAD 500C. A general purpose single lens reflex camera for use by photo tradesmen requiring small format photographs; a lightweight camera.

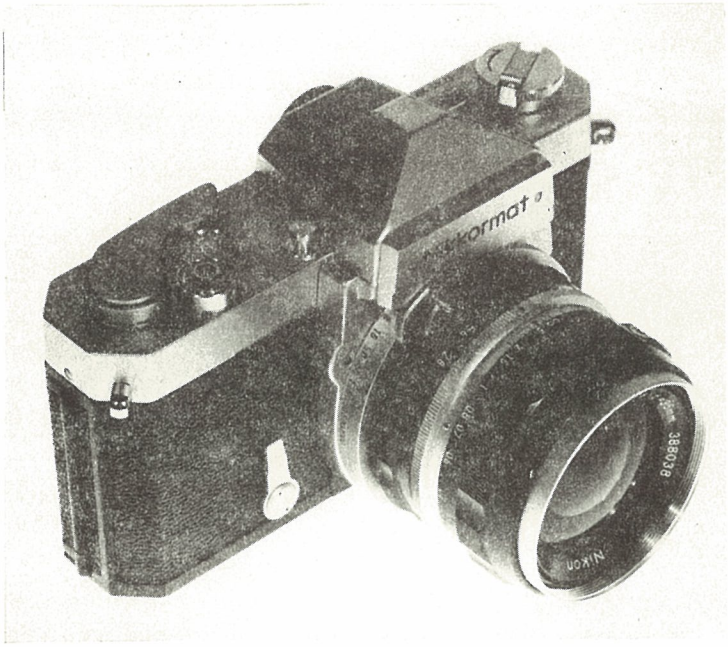

Figure No 41

CAMERA, STILL PICTURE 35MM SLR.
A 35mm single lens reflex camera for general purpose photography and production of slides.

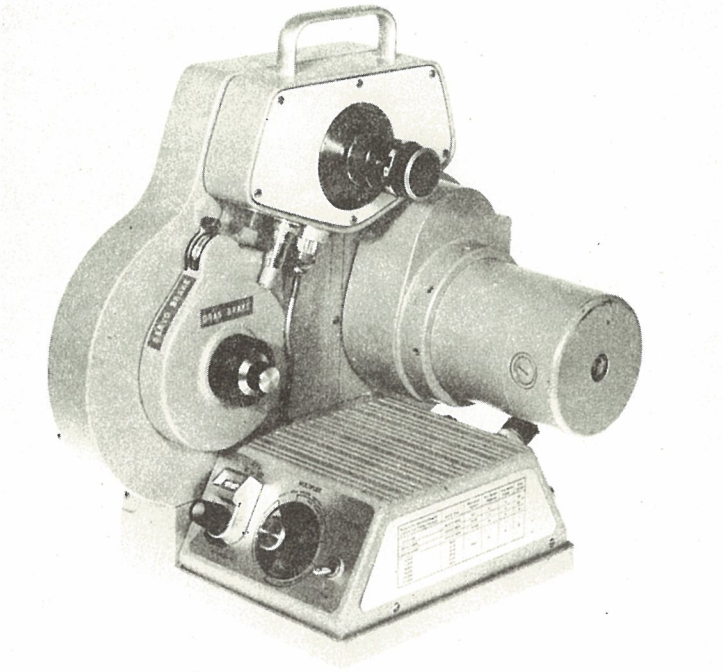

Figure No 42

CAMERA, 16MM HIGH SPEED HYCAM.
For high speed instrumentation photography equipped with canon zoom 12 to 120mm lens.

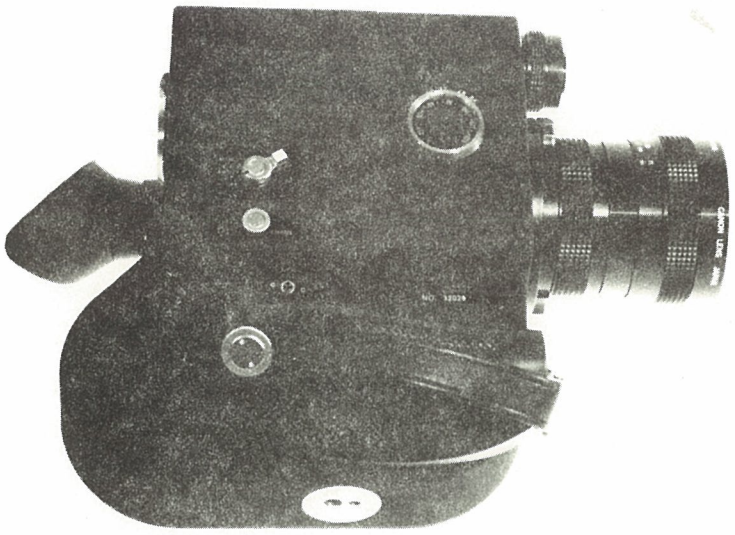

Figure No 43

CAMERA, CINE 16MM CANON SCOOPIC. Is a 16mm movie camera used to record facts. It is equipped with a zoom control and MACRO ring for greater versatility.

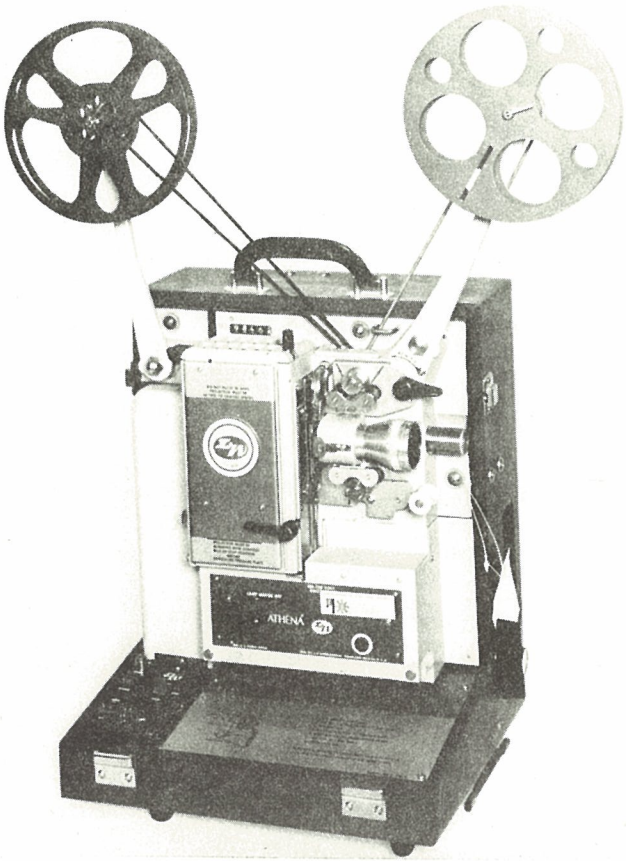

Figure No 44

PROJECTOR, ATHENA MK IV 16MM PROJECTOR (SILENT). A precision projector for photo-optical data analyzing of 16mm cine film.

TYPES OF TEST EQUIPMENT HELD IN E SQN

1. Following is a list of the types of electronic test equipment held by the E SQN Electronics laboratories. Some of the equipments used in the Electrical Metrology and Electrical Prototype and Fabrication Sections are illustrated in Figures 45 and 46 respectively.

AMMETERS
AMPLIFIERS
ATTENUATORS
BATTERY CHARGERS
BRIDGES
CAPACITOR TESTER
CALIBRATION STANDARDS EQPT
CHAMBERS, TEMPERATURE
CHROMOMETRIC DEVICES
CONDENSERS
CORROSION TEST EQUIPMENT
DELAY LINES
ELECTROMETERS
FILTERS
FREQUENCY MEASURING INSTRUMENTS
FREQUENCY CONVERTER
GALVANOMETERS
GAUSSMETERS
GENERATORS, PULSE
GENERATORS, SIGNAL
HYGROMETERS
IMPACT TEST EQUIPMENT
INDUCTORS
MAGNETIC, CHARGE & MEASURING EQPT
MEGGERS
METER, CRYSTAL IMPEDANCE
METER, POWER FACTOR
METER, Q
METER, RADIO NOISE & FIELD STRENGTH
METER, WOW & FILTER
MICROAMMETERS
MILLIAMMETERS
MILLIVOLTMETERS
MULTIMETERS
MULTIPLIERS
NULL DETECTORS
OPTICAL INSTRUMENTS
OSCILLOSCOPES
OSCILLOSCOPES, PLUG IN UNITS
PHASE METERS
POTENTIOMETRIC EQUIPMENT
POWER SUPPLIES, A.C. AND D.C.
PRESSURE MEASURING EQUIPMENT
PRINTERS DIGITAL
PSOPHOMETERS
RECEIVERS AND DETECTORS
RECORDING INSTRUMENTS
RECORDERS, SOUND
REGULATORS, VOLTAGE
RELAY TEST EQUIPMENT
RESISTORS
SEMICONDUCTOR MEASURING EQUIPMENT
SHUNTS
SOUND MEASURING EQUIPMENT
SPECTRUM ANALYZERS
STROBOSCOPES
SWITCHES, TIME
TELEGRAPH DISTORTION SETS
TELEPHONE TEST SET
TEMPERATURE MEASURING EQUIPMENT
TERMINATION UNITS
TORQUE MEASURING EQUIPMENT
TRANSFORMERS
VACUUM TUBE TESTERS
VIBRATION EQUIPMENT
VOLTAGE DIVIDERS
VOLTMETERS
V.S.W.R. SETS
VOLUME LEVEL METERS
WATTMETERS
WAVEFORM ANALYZERS

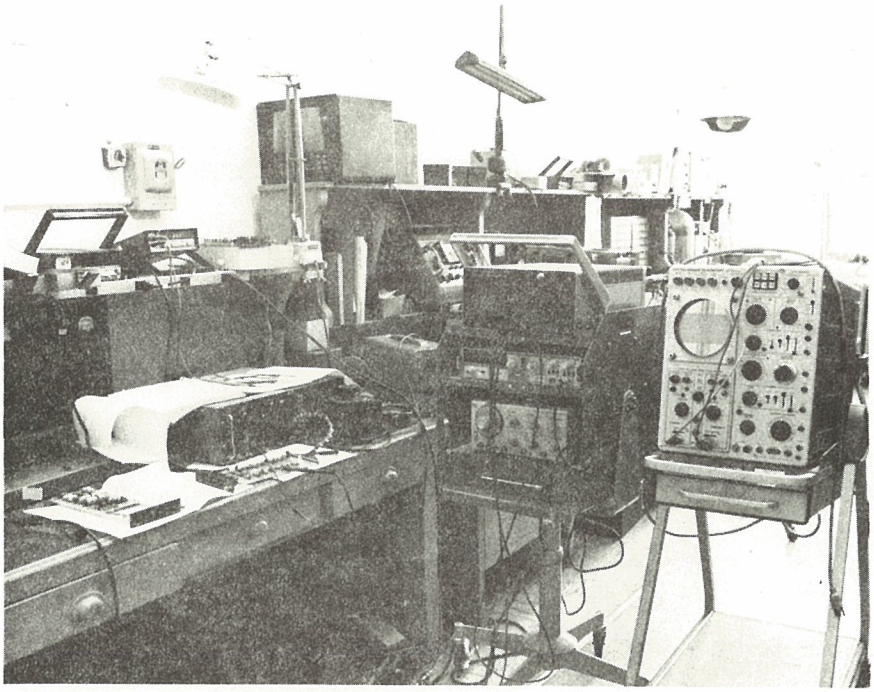

Figure No 45 -- Some of the test equipment used in the Electrical Metrology Section.
(Neg No EE77 1014)

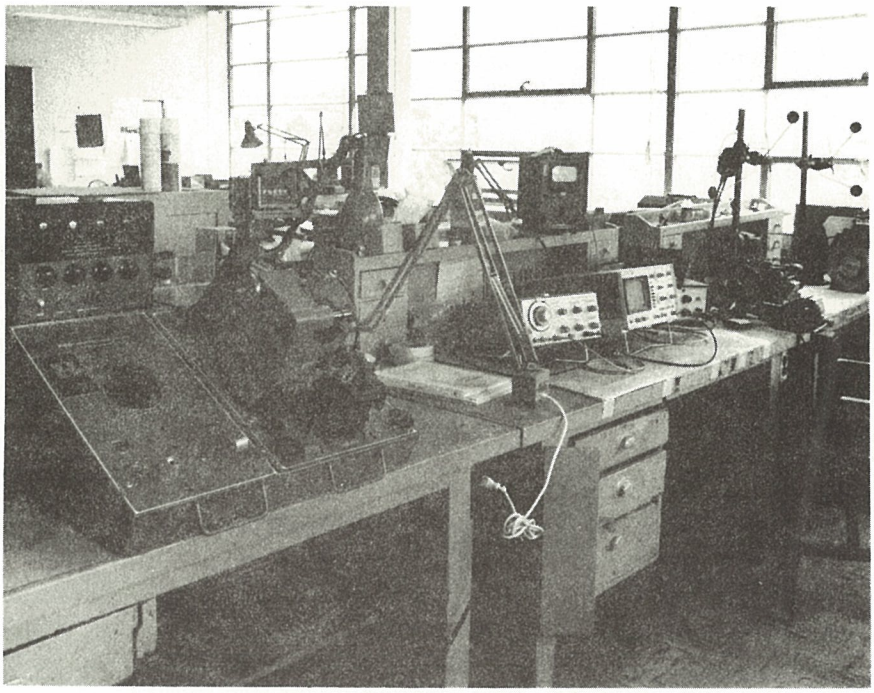

Figure No 46 -- Some of the equipment used in the Electrical Prototype and Fabrication Section.
(Neg No EE77 1022)

ENVIRONMENTAL TEST SECTION EQUIPMENT

EQUIPMENT	OPERATION PERFORMED AND PURPOSE
Weather Chamber Walk-in	To provide simulated climatic conditions. Temperature range - minus 80 degrees to plus 160 degrees Fahrenheit. Relative humidity from 15 percent to 100 percent. Enables personnel to enter and conduct tests under adverse temperature conditions. A four stage refrigeration plant is situated in a separate room adjacent to the chamber.
Bowser Climatic Chamber Reach-in	To provide simulated climatic conditions. Temperature range - minus 60 degrees to plus 200 degrees Fahrenheit. Relative humidity from 15 percent to 100 percent. Altitude range from normal atmosphere up to 50,000 feet, and eight pen recorder with thermocouples is provided to record the temperature within the chamber.
American Research Climatic Chamber Reach-in (Fig 47)	To provide simulated climatic conditions. Temperature range - minus 110 degrees to plus 200 degrees Fahrenheit. Relative humidity from 15 percent to 100 percent automatically programmed and recorded. Altitude range from normal atmosphere to 90,000 feet. This is a fast temperature change type chamber, to simulate typical aircraft changes.
Cold Chamber Reach-in	To provide temperature conditions from room ambient to minus 50 degrees Fahrenheit for long term storage tests up to two years.
Barlow-Whitney Relative Humidity Chamber Reach-in	To provide temperature and humidity conditions from room ambient to plus 230 degrees Fahrenheit and a relative humidity up to 100 percent.
Blue M Humidity Chamber Reach-in	To provide temperature and humidity conditions from room ambient to plus 200 degrees Fahrenheit and a relative humidity up to 100 percent.
Cenco Temperature Oven	To provide temperatures range from room ambient up to plus 200 degrees Fahrenheit.
Cenco Temperature Oven	To provide temperatures from room ambient up to plus 400 degrees Fahrenheit.
Cenco Temperature Oven	To provide temperatures from room ambient up to plus 200 degrees Fahrenheit with forced air circulation.

EQUIPMENT	OPERATION PERFORMED AND PURPOSE
Rain Chamber (Fig 47)	To simulate driving rain using eight spray nozzles and recirculated fresh water. This chamber can simulate up to 20 inches of rainfall per hour.
Singleton Salt Spray Chamber (Fig 48)	To simulate atmospheric conditions of an ocean environment. The density of the salt solution is from 20 percent sodium chloride and is temperature controlled up to 150 degrees Fahrenheit
MB Manufacturing Co. Electro-Dynamic Vibrating Exciter (Fig 47)	To provide a sinusoidal vibration motion in a vertical table direction to simulate vibrations experienced in vessels, vehicles, and aircraft. The system is capable of producing accelerations up to 35.7 "g" units, and displacement of up to 300 milli-inches at frequencies ranging from 5 to 500 cycles per second. Maximum test load of 130 pound. This vibration exciter is utilized to excite the following two pieces of equipment to increase its versatility.
CASEE Vibration Suspension Table	Facilitates an increase in the test load up to 300 pounds of the Electro-Dynamic Vibration Exciter Table in a vertical direction.
Allied Research Horizontal Vibration Test Table	To provide the means for vibration in the horizontal direction using the Electro-Dynamic Vibration Exciter.
Waugh Johnson Vibration Machine (Fig 48)	To provide a sinusoidal vibration motion in a vertical direction to simulate vibrations experienced in vessels and vehicles. The machine has a frequency range from 10 to 60 cycles per second; the capability to produce up to 10 "g" units and displacements up to 65 milli-inches. The vibration test load is up to 100 pounds.
All American Tool Vibration Machine	To provide a sinusoidal vibration motion in a vertical direction to simulate vibrations as experienced in vessels and vehicles. The machine is capable of producing accelerations up to 28 "g" units and displacements up to 250 milli-inches, with a frequency range from 10 to 60 cycles per second.
British Admiralty Shock Test Machine (Fig 49)	To provide an acceleration impact of up to 1,000 "g" units with a short duration of one milli-second. The test load up to a maximum of 400 pounds. Provides high impact shock, to simulate underwater explosions, in three mutually perpendicular directions.

EQUIPMENT	OPERATION PERFORMED AND PURPOSE
Barry Controls Varipulse Shock Test Machine	To provide impact shock having half sine, saw-tooth and square wave form. The machine is capable of producing acceleration and time duration requirements of Military Standard 810 and Military Standard 202.
MIL-STD-202A Shock Machine	To provide impact having a time duration and acceleration meeting the requirements of Military Standard 202A. This machine is used for the testing of panel meters and small components.
CASEE Low Impact Shock Tester	To provide a portable low impact having a force of one foot pound. This is used to test small samples of material under extreme temperature conditions.
L.A.B. Bounce Machine (Fig 48)	To provide synchronous and non-synchronized bounce of one inch at speeds up to 300 cycles per minute with a table pay load up to 400 pounds. This machine is to simulate vehicle and railway car movement.
CASEE Reciprocating Motion Machine	To provide a reciprocating or semi-circular motion for endurance testing, with a frequency range from 0 to 110 motions per minute.
AVCO Corporation Test Fixture	To provide a fixed pattern mounting for vibration testing of components and equipment without introducing additional resonant modes to specimens under test.
Dweyer Velocity Tester	To make accurate air velocity measurements in environmental chambers. Velocity range from 300 to 4,000 feet per minute.
Immersion Tanks	To provide a means of immersing components and equipment in fresh water. Size range of tanks are 13½ inches diameter by 36 inches deep, 24 inches by 24 inches by 48 inches and 24 inches by 48 inches by 48 inches.
Endevco Acclerometers	To provide a means of measuring impact acceleration up to 20,000 "g" units having a frequency response up to 15 kilocycles, in temperatures from minus 65 degrees to plus 230 degrees Fahrenheit. The equipment consists of one power supply and a separate amplifier for each of four accelerometers.

EQUIPMENT	OPERATION PERFORMED AND PURPOSE
Gulton Glennite Accelerometers	To provide a means of measuring vibration accelerations up to 400 "g" units having a frequency response up to 10 kilocycles, at normal room temperature. The equipment consists of one power supply and a separate amplifier for each of four accelerometers.
Columbia Accelerometers	To provide a means of measuring vibration accelerations up to 40,000 "g" units having a frequency response up to 10 kilocycles in temperatures from minus 100 degrees to plus 350 degrees Fahrenheit. The equipment consists of a three channel power amplifier and three accelerometers.
MB Manufacturing Velocity Transducers	To provide an accurate measurement of vibration velocity.
MB Manufacturing Vibration Meter	To make accurate measurements of acceleration, velocity and amplitude of vibrating specimens.
Cambridge Instruments Vibrograph A Siesmic Instrument	To provide a means of recording vertical, horizontal, rotational or spot vibrations within a specimen.
Chadwick-Helmuth Slip-Sync Equipment	To provide a high intensity stroboscopic light focused to a vibrating test object for visual observation to determine any structural defects. A voltage output from a vibration transducer is fed into the slip-sync unit which automatically follows the change of vibration frequency and produces a synchronizing action within two or three cycles per second to excite two high intensity stroboscopic lights simultaneously thus appearing to stop the motion of vibrating specimens under test, except those vibrating out of pace with the induced frequency.
Microscope Optical Measurements	To provide accurate measurements of minute flows etc.
Photostress Viewer	To provide a visual means of measuring the stress on metals after physical testing.
CASEE Sound Isolation Chamber	To provide a means of insulation from ambient noise when testing microphones and earphones.
Sound Pressure Measurement Facilities	To provide a means of electro-acoustical measurement of earphones and microphones.

EQUIPMENT	OPERATION PERFORMED AND PURPOSE
Hygrodynamic Inc. Electric Hygrometer Indicator	To provide a laboratory standard for relative humidity measurements.
Thermotron Temperature Chamber Reach-in	To provide temperatures in the range - minus 100 degrees Centigrade to plus 200 degrees Centigrade. This is a fast temperature change chamber.

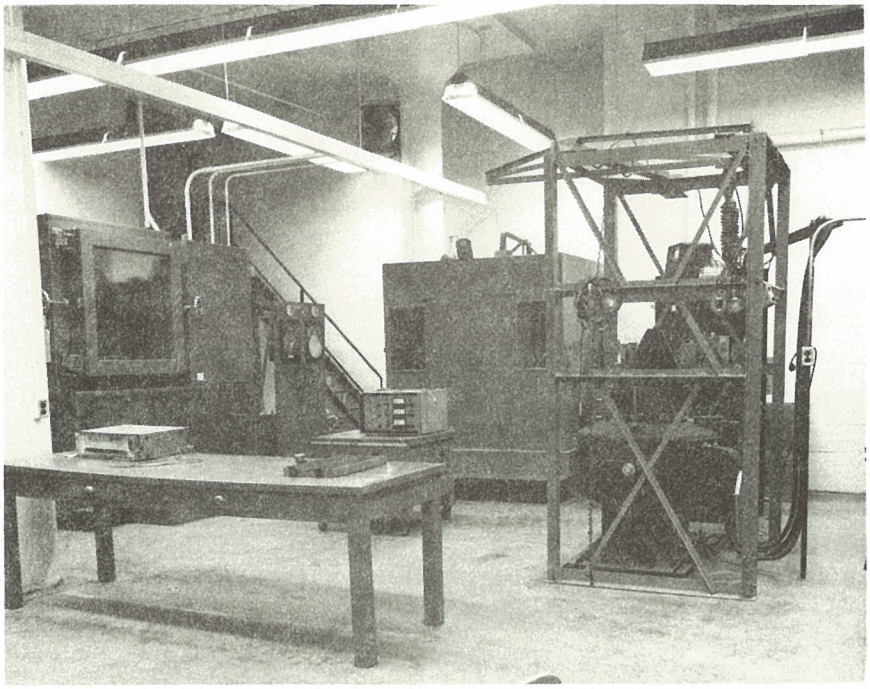

Figure No 47 -- Environmental Test Section Equipment.
Left - American Research Climatic Chamber.
Centre - Rain Chamber.
Right - Electro-Dynamic Vibrating Exciter.
(Neg No EE77 1025)

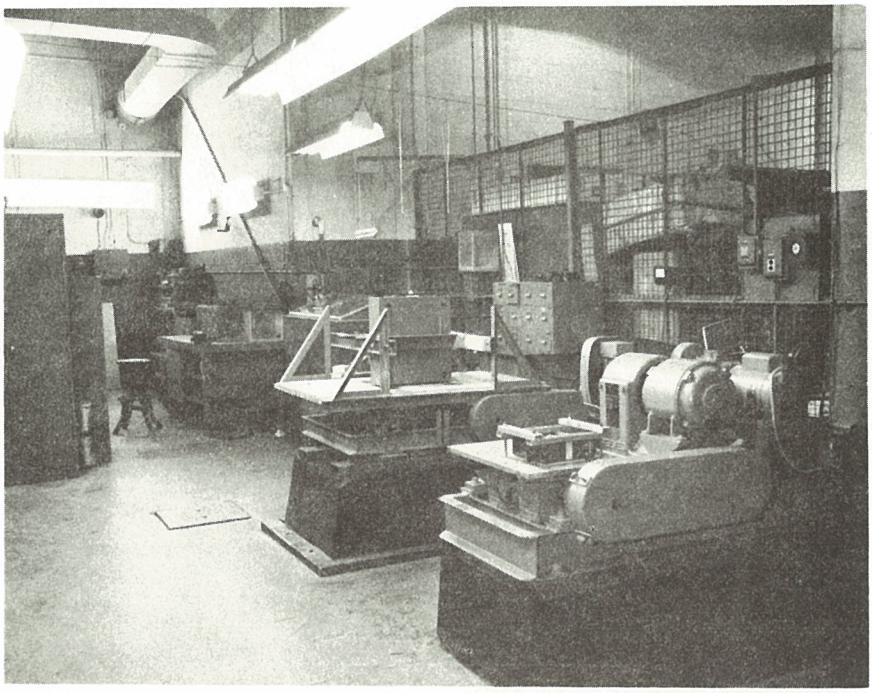

Figure No 48 -- Environmental Test Section Equipment.
From the front - A Waugh Johnson Vibrating Machine, a L.A.B. Bounce Machine and a Singleton Salt Spray Chamber. (Neg No EE77 1026)

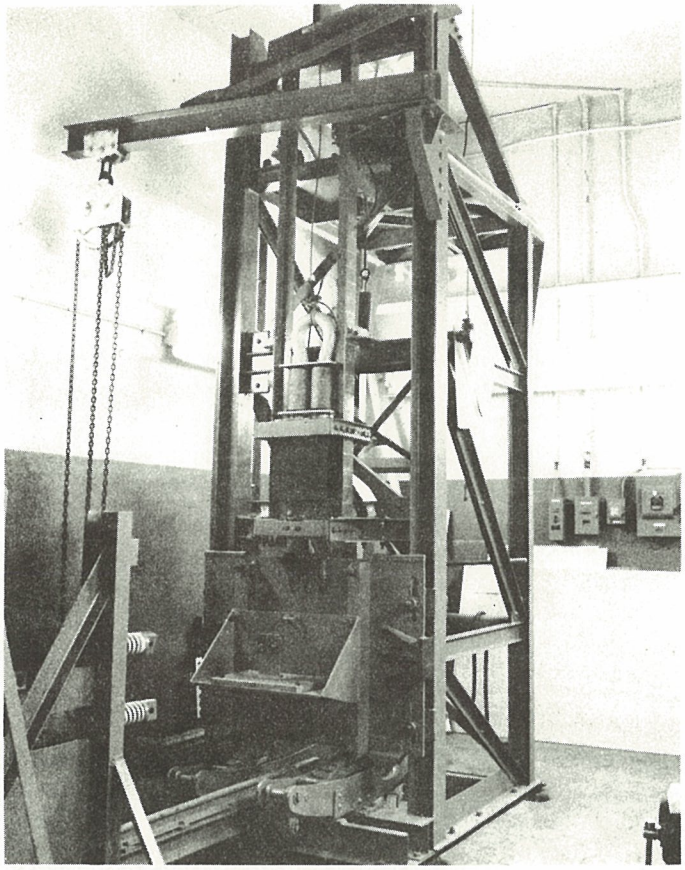

Figure No 49 -- A British Admiralty Shock Test Machine.
(Neg No EE77 1013)

MECHANICAL PROTOTYPE AND FABRICATION EQUIPMENT

1. Following is a list of the equipment held by the Prototype and Fabrication Section of E SQN.

a. NC Strippett Punch, numerically controlled and programmed using a digital PDP8 mini-computer.

b. A total of eight lathes.

c. Six standard milling machines.

d. Power shears.

e. Hydraulic form press.

f. Two metal hand breaks.

g. Manual metal shears.

h. Iron working machine.

j. Nibbling machine.

k. Three grinders, one cylindrical, one surface grinder and one tool and cutter grinder.

m. Rubber mould press.

n. Plastic injection moulder.

o. Two metal cut-off saws.

p. Two band saws.

q. Various bench grinders.

r. Heat treatment facilities.

s. AC and DC welding, tig welding, oxygen-acetylene and spot welding.

t. Boring mill.

u. Engraving machines.

v. Hand press and hydraulic press available for assembly and disassembly of components.